

Jane's

WORLD WAR II TANKS AND FIGHTING VEHICLES THE COMPLETE GUIDE





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THE COMPLETE GUIDE

LELAND NESS



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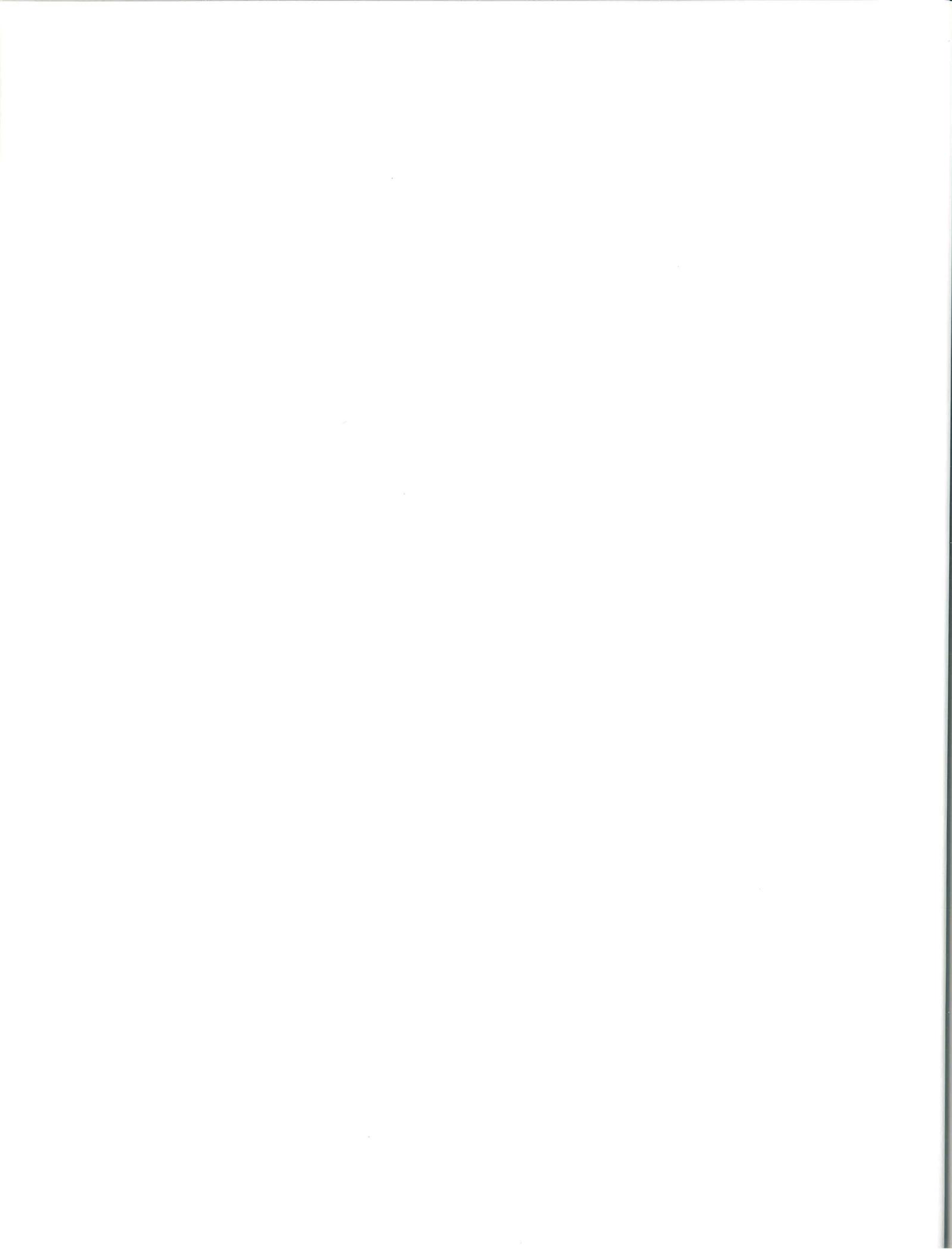
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Contents

<i>Preface</i>	7
<i>Introduction</i>	9
Britain	16
British Commonwealth and Empire	48
Czechoslovakia	62
France	70
Germany	84
Hungary	114
Italy	122
Japan	134
Poland	146
Soviet Union	150
Sweden	172
United States	182
Other Countries	212
<i>Index</i>	229



Preface

It is probably possible to fill a small library (and a large hard drive) with the material published on the subject of armored vehicles of World War Two. The works range from small global surveys to massive and highly detailed histories of particular models and variants.

It was thus with some trepidation that I undertook this work, which must necessarily only scratch the surface of this apparently well-documented field. It quickly became apparent, however, that the works so far published concentrated on only two general areas of interest. The first, and most numerous, were those detailing the technical characteristics of the vehicles. In the case of "popular" vehicles, these were often huge tomes containing incredible levels of detail. The second, and less

common, dealt with the operational use of these vehicles.

Nowhere, however, was there a comprehensive study of who got what, who built what, when, and how many. Thus was born this book. Much of the data is drawn from US, German, British and French archives, and reconstruction of destroyed Japanese archives in 1945-46. While German production has been well documented, and that of the US, Soviets and Italians available to serious researchers willing to piece together fragments, production in other countries, such as Britain and Japan, has been largely ignored. It is hoped that the tables provided here will help fill those gaps.

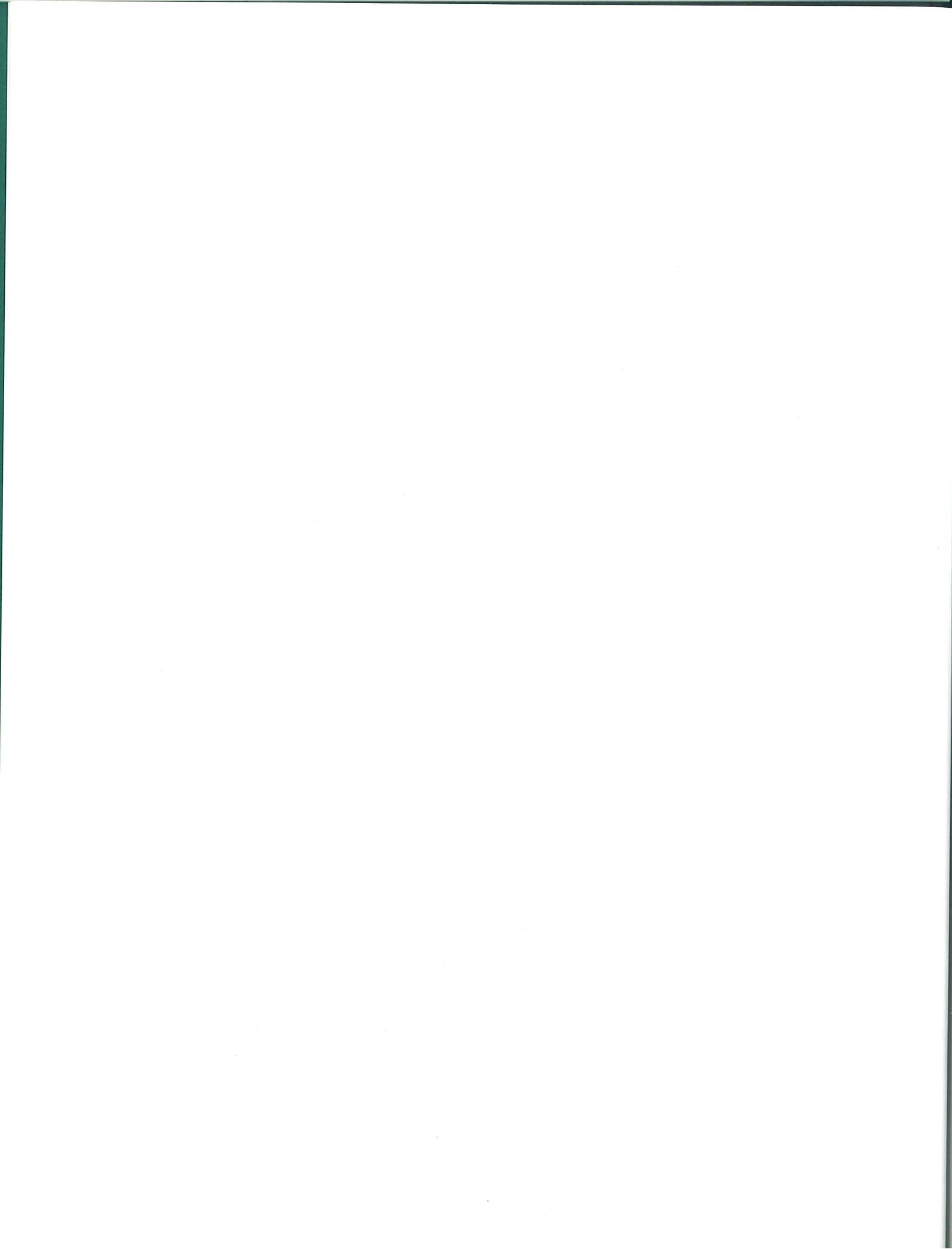
Photo credits are: KAS = Krigsarkivet, Stockholm, PMK = Patton Museum, Fort

Knox, TMB = Tank Museum, Bovington.

In any work errors, hopefully just minor, are inevitable. In a brief overview of a subject, such as this one, simplifications of complex issues are necessary. I hope I have kept both errors and over-simplifications to an absolute minimum. Many colleagues provided valuable input for this work. Steve Zaloga, Jeff McNaughan, David Fletcher, Akira Takizawa, Nowfel Leulliot, Jean-Guy Rathé, Henry Klom, Joël Montagu, and many others provided input and corrected the errors that they saw. Such errors as survived, of course, are entirely my own.

And, of course, thanks also to Janet for her patience and forbearance.

Leland Ness
Alexandria, Virginia



Introduction

Two weapons that debuted during the First World War revolutionized the Second: the combat airplane and the armored fighting vehicle. They shared another trait: in both cases equipment perfectly serviceable at the start of the war in 1939 were absolute deathtraps by obsolescence within two or three years. Another remarkable feature of both was the dramatic, in some cases exponential, increases in production rate over the course of four years of war.

Unlike aircraft, however, the increased power of tanks was due not to technological progress (with a few exceptions) but to simple scale-up. Where combat aircraft saw the introduction of the jet-engine and airborne radar, among others, the vehicles, and their guns, simply got bigger. That is not to say that there was no technology insertion, but that it tended to be incremental and considerably less dramatic.

Debates over whether increased protection levels spurred the development of more powerful guns, or vice versa, is probably pointless. The fact is, however, that both increased greatly.

The increase in firepower was due not so much to improved technologies as to increase in gun size. In contrast to today's tank guns, which generally fire at about 1,500 metres per second, World War Two saw little improvement. In the case of the US the early 37mm M6 fired AP ammunition at 880 m/s, while the standard mid-war 75mm M3 used in the Sherman reached only 615 m/s, and the late war 76mm M1A2 managed to get back to 790 m/s. The British managed to maintain a constant 850 m/s

through the war, with their 2pdr (40mm), 6pdr (57mm) and 17pdr (76mm) guns. The first German tank gun, the 37mm KwK, fired at 745 m/s, the short- and long-barrelled 50mm at 685

and 835 m/s, respectively, while the 75mm L/48, standard on the later PzKw IV tanks, fired at 790 m/s. The real breakthrough came with the 75mm L/70 of the Panther (925 m/s) and



Right: The Austrian tank battalion in 1936; typically for the time relying on machine gun carriers and armoured cars.



the 88mm L/71 (Tiger II) at 1,000 m/s.

Some improvements in these figures were made possible by the use of special ammunition, in particular composite ammunition in which a heavy (usually tungsten alloy) core was encased in a light metal shell body. Being lighter than the normal armor-piercing round, it came out of the barrel at a higher velocity. In the case of the German guns, this usually added about 180 m/s to the muzzle velocity, and 240 m/s to the velocity of US 76mm gun. This was an example of technology insertion into the field of tank design, but the rounds worked imperfectly and, because these early designs carried the light

Above: A Japanese tank unit arrives for service; China, 1937. Type 89s traversed their turrets for rail transit.

outer body with them, they lost velocity quickly, thus losing their advantage at longer ranges.

Instead, the bulk of the improvements to armor penetration came through the adoption of larger guns. In the case of Germany this meant moving from the 37mm gun (with a 0.69 kg projectile) at the start of the war, to a 50mm gun (2.06 kg) in 1941, to a 75mm gun (6.8 kg) in 1942 and finally, for its heavy tanks, to an 88mm gun (10.2 kg), a 15-fold increase in shell weight. Armor penetration did not rise at the same rate, but still increased from 29mm at a range of 500 metres for the 37mm, to 138mm for the Panther's long 75mm gun, both using standard armor-piercing ammunition.

Simultaneously, of course, armor protection was improving. In part this was accomplished

by simply using thicker armor plate. Frontal armor thicknesses of about 15mm (Soviet T-26 and British Cruisers I and III) to 30mm (German PzKw III and British Cruisers II and IV) at the start of the war gradually gave way to 50mm (US Sherman and Soviet T-34) to 110mm (German Panther). Of equal importance was the move to curved and sloped armor. This not only increased the effective (line-of-sight) thickness of the armor, but also reduced the volume to be protected, thus reducing armor weight, enabling even thicker armor to be used.

The growth in tank weight was, in turn, made possible by the development of larger power plants. In some cases these were new units, although others were existing aircraft engines such as the Liberty and Merlin, derivatives



thereof, such as the Ford GAA, or combinations of engines, such as the Chrysler A57 multibank unit. The only major technology infusion came with the introduction, near the end of the war, of the Maybach HL-234 for the last batches of Tiger II tanks, this engine featuring fuel injection, a process pioneered earlier by aircraft engines.

Transmissions and steering were also improved during the war, again using mainly concepts devised earlier. A few early vehicles, such as the PzKw I, the T-26, British light tanks up to the Mk VI and cruisers up to the Mk IV used clutch-and-brake steering, and the Soviets continued to use it through the war for the T-34s and KV's. Geared steering showed up in Landsverk, Czech and Japanese tanks of the 1930s and quickly spread in popularity. Controlled differential steering was provided on all US wartime tanks.

One area that did see some improvement was the suspension. Early tanks simply used multiples of two or more small roadwheels mounted on a centrally-pivoting balance beam ("bogey"). These balance beams were mounted on the hull by stiff springs or themselves combined on larger balance beams. The

springs, however, were very stiff and provided only limited travel, so the suspension worked mainly as a "walking beam" to equalize the pressure on the pairs of wheels on each beam. This greatly limited cross-country speed and it was modified to individually spring the wheels on each bogey, pioneered by the Horstmann company of Britain in the early 1930s. Variations on this type suspension were used by a wide variety of tanks, including all American light tanks up to the M5 and medium tanks through the M4 Sherman. The major improvement came with the development of large roadwheels, independent sprung, by the American JW Christie in the late 1920s. Their lower unit mass and greater travel dramatically improved cross-country performance and they were adopted with success by the Soviets and the British for their medium/cruiser tanks. The springs of the Christie suspension took up a lot of room, however, and some designers chose to replace them with torsion bars, and these were used successfully in Soviet heavy tanks and in US vehicles such as the M24 light tank and the M18 tank destroyer, the latter the fastest tracked combat vehicle of the war.

Another significant area of incremental improvement was in communications. By 1939 the importance of radios in tanks had become clear. All German tanks were fitted with radios (although only receivers in some light tanks), as were all British tanks except the small Mk I infantry tanks. Slower to get the message were the French, whose light infantry tanks (the bulk of their tank force) had no radios and the Japanese and Soviets, who fitted them only to platoon-and-higher command tanks. By mid-war two-way radios had become standard in almost every tank. At the same time more efficient models were introduced, although in most cases they could operate only when the tank was stationary. The US introduction of FM radios, which could operate on the move, was a boon to tactical cooperation.

The importance of radios is often underestimated and was particularly striking during the opening phases of the war. The British and French armies both specified that each rifle platoon should have its own backpack

► Above: Successful on paper, the Hotchkiss 35 was severely hampered by its two man crew and lack of radio.



radio, but in fact this gear was new and thus both unreliable and in short supply. Once a battle became fluid and telephone lines useless, the tank forces had a tremendous advantage over the infantry. The tank unit commander had a pretty good chance of knowing, at least generally, where his forces were and what they were doing, and was capable of changing orders to meet new circumstances. The poor infantry commander, on the other hand, often had little knowledge of where his troops were or the means of effectively controlling them. The stunning successes of the Panzer arm in the first two years of war must be attributed as much to superior tactical communications as to any other factor.

A non-technical innovation resulted from the

Above: One of the first modern tanks of the late 1930s, a PzKw IV enters a French village in 1940.

British and German realization in the mid-1930s that there were three jobs in the tank turret that often had to be accomplished simultaneously in combat. The commander had to search for targets and keep looking for potential threats from all directions. The gunner had to use a magnifying telescopic sight to focus all his attention on hitting a particular target chosen by the commander. The loader had to retrieve ammunition from the bins and reload the main weapon for rapid fire, as well as service the coaxial machine gun. From that it followed that three men were needed to operate a turret efficiently.

This was not immediately apparent to all tank designers, however. French tanks, even the cavalry tanks intended for mobile warfare, continued to use the spectacularly inefficient one-man turret. The Soviets opted for a two-man turret, as did the US initially with its M2

medium tank, and the Japanese. The US moved to the three-man turret with the M4 Sherman that entered production in January 1942, while the Soviets did not adopt it until the introduction of the T-34/85 Model 44 in early 1944.

More remarkable than the technological innovations was the massive expansion of production. In most of the major tank-producing countries construction of tanks and their derivatives (tank destroyers, assault guns, SP artillery, etc.) increased 10-fold, and in some cases much more than that, between the late 1930s and 1943/44. Significantly, this was happening at the same time that tanks increased greatly in size, thus requiring massive expansion of industrial facilities just to produce the new, larger tanks, even without considering the increased quantities. Thus, for example, the tanks built in the US in 1940 totaled 3,830

JANE'S TANKS OF WORLD WAR II

Below: An infantry Commander rides on an early StuG 40 to ensure coordination on the then-new Eastern front, 1941.

tons, or 10.5 tons apiece average. By 1943 the tank output had increased to 961,600 tons, this staggering 251-fold increase in three years being due not only to the increased quantities, but also to the fact that the average weight had increased to 25.8 tons.

This was accomplished by different means in different countries. The Soviet Union had begun to develop its tank industry in the early 1930s and by 1937 was building more tanks than the rest of the world combined. This existing base of production facilities and expertise gave them a tremendous advantage and helped ensure that the heroic efforts to relocate the tank plants out of the German advance during late 1941 would succeed. The British had no such luxury and largely had to develop capacity almost from scratch. They accomplished this by farming out small contracts to a number of civilian factories to "familiarize" them with tank production. This proved an unfortunate expedient, for the various plants invariably went their own way in time, resulting in small production runs of a

	1937	1938	1939	1940	1941	1942	1943	1944
USSR	1,558	2,270	2,988	2,669	6,449	24,713	24,227	29,029
USA	150	99	18	365	4,021	26,608	37,198	20,357
Britain	144	408	752	1,382	4,851	8,190	7,329	4,057
Japan	347	317	570	1,068	1,269	1,375	990	387
Italy	n/a	n/a	100	300	1,050	900	500	n/a
Germany	300	812	743	1,479	3,057	3,463	12,780	16,832

Production of Tanks and Derivatives

large variety of models with little central direction. Similarly, the Japanese relied on civilian heavy equipment manufacturers, who set aside a portion of their factory space for the production of tanks. Once again, this proved inefficient, but then tanks were never a high priority. Italy continued to rely almost exclusively on the Fiat-Ansaldo monopoly in the form of the facility in Genoa for production, which severely limited capacity and probably innovation as well. The Germans set up tank factories under the direction of existing industries, but appear to have eschewed "hard tooling" for fear it would slow down the introduction of modifications. This appears to have limited production to some extent.

The US was blessed with a large industrial base but almost no knowledge of tank production. The only plant building tanks in 1939 was Rock Island Arsenal, which produced them almost by hand. One solution, common to other countries, was to tap the expertise of railroad and locomotive producers, who were intimately familiar with heavy industrial work. This was facilitated by large-scale British contracts placed in 1940 and 1941. The locomotive firms proved efficient and useful, but were not oriented by nature to mass production. Instead, attention turned to the automobile industry and in August 1940 Chrysler was awarded a contract that gave them almost carte blanche to design and build a large factory solely for the production of medium





tanks using auto industry assembly-line techniques. The project was successful and by 1943 the Detroit Tank Plant was building 550 Shermans a month.

The increasing lethality of other tanks and anti-tank weapons, however, meant that in many cases this increased production served only to replace horrendous losses. Aside from a disastrous plunge in numbers following the

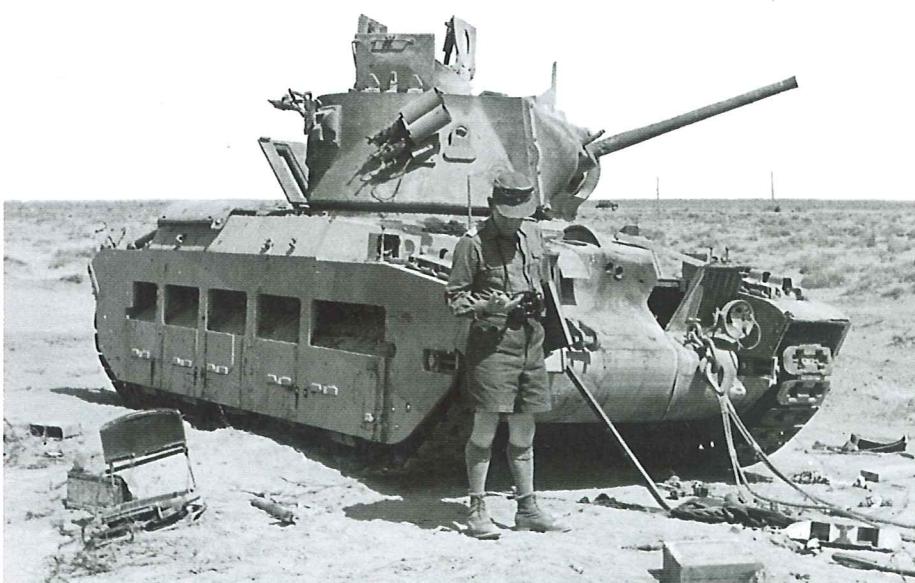
initial German invasion, Soviet tank strength fluctuated between 20,000 and 25,000 through the war. German tank strength between mid-1941 and early 1945 varied only between 4,900 and 6,300 in spite of increased production. The tank strength of the US and Britain increased due to much smaller tank losses during 1942-44.

Of equal importance was the development of

Above: A German SdKfz 263 radio version of the early 8-wheeled armoured car in North Africa, 1941.

specialized accompanying armor. The US and the Germans (and to a lesser extent the French in 1940) provided their armored forces with infantry in armored vehicles, enabling them to accompany the tanks. Self-propelled artillery provided the supporting fire, while reconnaissance vehicles with excellent cross-country performance let the tanks know what they were about to run into. Similarly, armored recovery vehicles permitted the quick repair of broken down and damaged vehicles. All these made possible the efficient combined-arms operations pioneered by the Germans early in the war and later adopted by the Western Allies. Nevertheless, it has to be noted that they were apparently not absolutely necessary if one was willing to accept greater casualties. The Soviets had few armored personnel carriers and no mobile indirect-fire artillery, but used their tank and mechanized corps to great effect in 1944-45.

Left: Vast flat terrain encouraged the most pure form of tank combat during 1941-42. Preparations to recover an abandoned British Matilda.



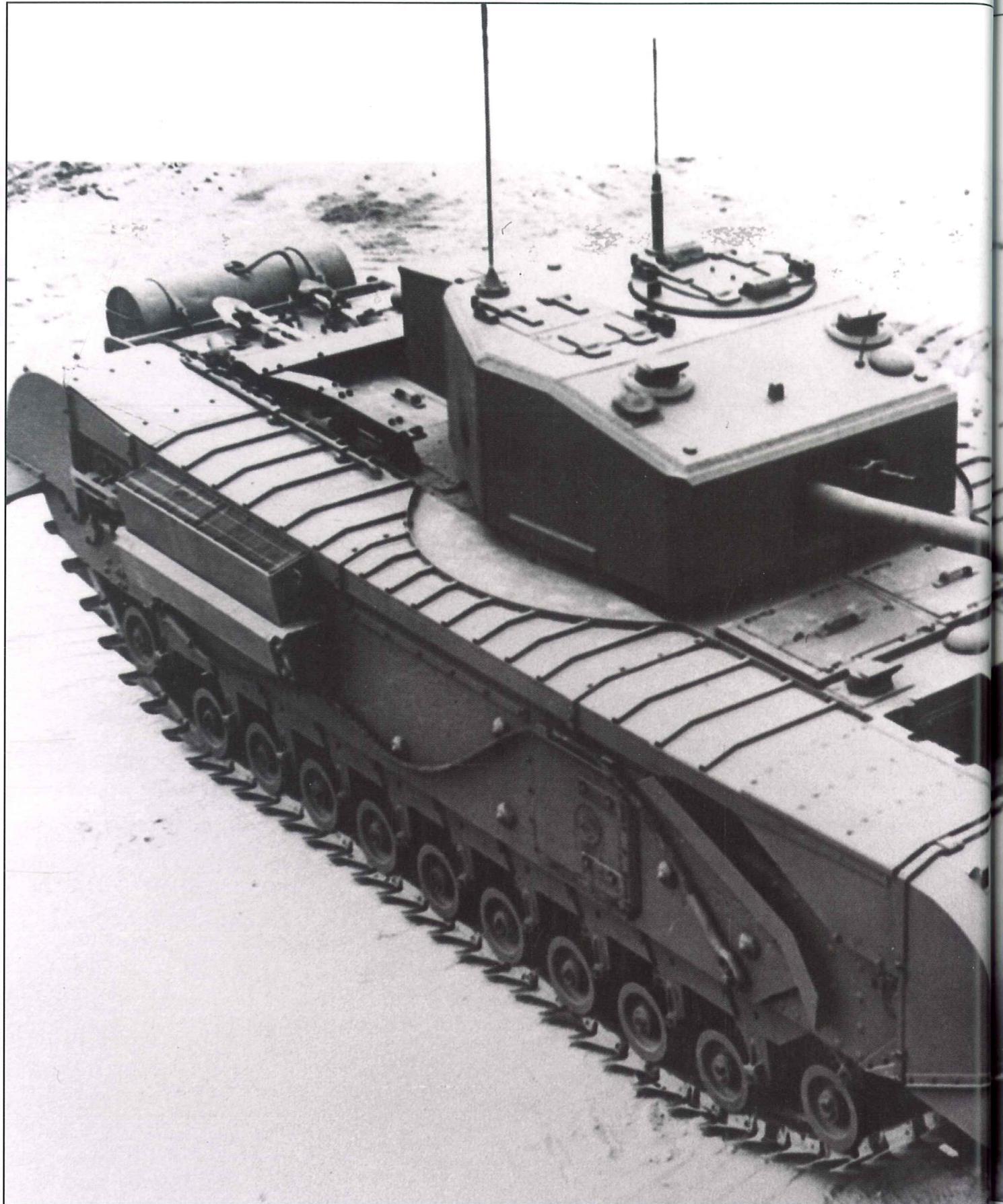


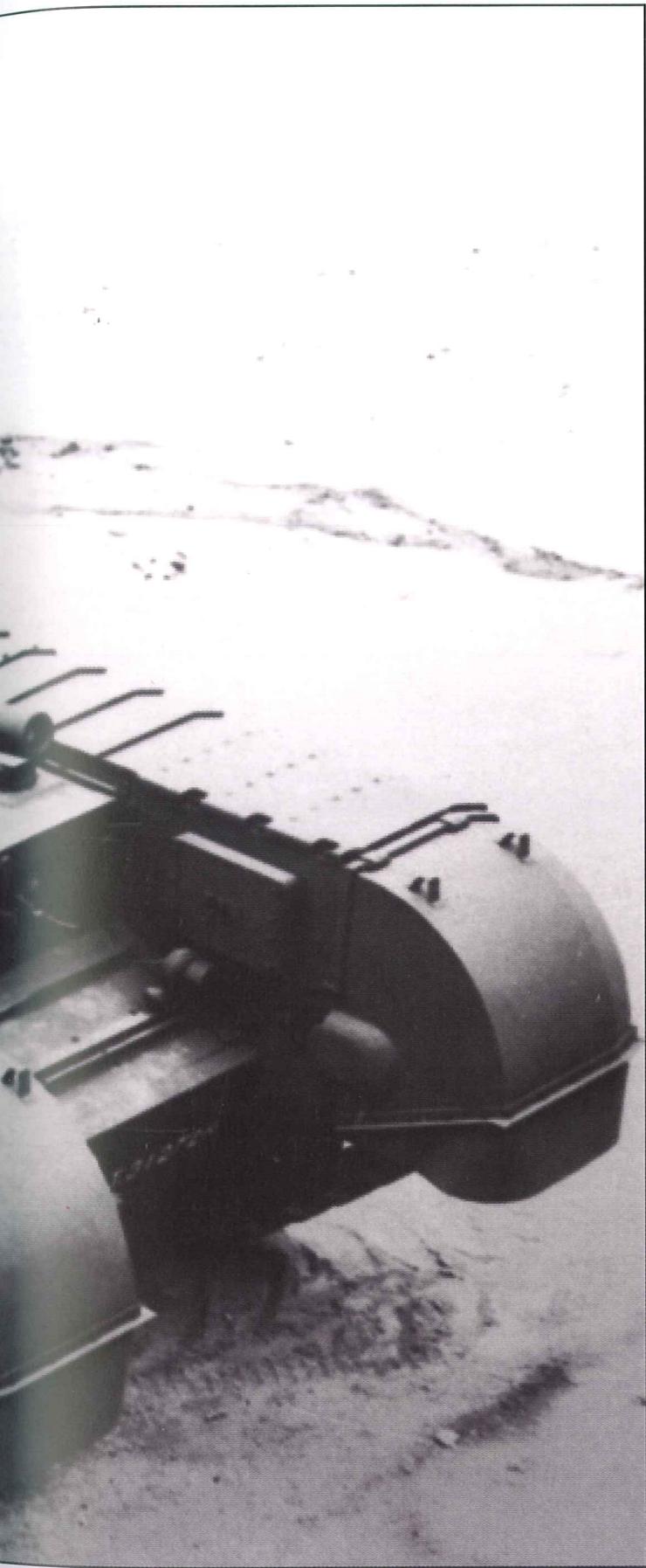
Above: The M20 utility car, a variant of the M8 armoured car; seen here as part of the 6th Cavalry Group in Germany, 1945.

What the machine gun was to World War One, the defining weapon of the conflict on the ground, the tank was to World War Two. While the infantry bore the brunt of the battle and suffered most of the casualties, it was usually the tank that made the pivotal thrust, the decisive maneuver that decided victory or defeat on the operational level. In those areas where terrain prevented the tank from playing this role, for instance in the Pacific, Burma and Italy, the war tended to be slower and very bloody per yard gained.

Right: The most lethal and feared tank of the war – a row of Tiger IIs in late 1944.







Britain

On the first day of the war in September 1939 the British tank factories were turning out tanks generally comparable to their foreign counterparts. On the last day, in August 1945, they were producing excellent tanks, including the Centurion that would stand the test of time for the next 30 years. Unfortunately, what came between was often uninspired and sometimes downright wretched. The seeds of disaster had been planted before the war and it would take the better part of the war to cull out the weeds and concentrate on the good designs.

Interwar Tanks

The beginning was auspicious enough, given the general mood of disarmament sweeping the West after the Great War. The War Office and Vickers designed a new medium tank that went into production in 1923 as the Mk I, featuring a sprung suspension, air-cooled engine and a rotating turret with a 3pdr (47mm) gun. Although hardly an ideal combat machine, it was far in advance of anything anyone else was proposing to build and placed Britain on a fast track in tank development. Subsequent improvements, mostly to the powertrain, yielded the Mk IA, Mk II and Mk IIA, the last of these being ordered in 1928. A total of 168 of these vehicles were built, split about 60/40 between Vickers-Armstrong and the state-owned Royal Ordnance Factory at Woolwich.

In 1926 the War Office announced a requirement for an all-new medium tank and two design teams set to work. The Vickers effort resulted in the A6 (better known as the 16-tonner), while that at Woolwich yielded the A7. When prototypes were delivered the A6 proved too expensive for a parsimonious Treasury, while the A7 contained significant operational shortcomings. Three Medium Mk III were ordered, using some of the design concepts of the A6, but otherwise both vehicles proved a dead end.

More successful was the Vickers effort to develop a private venture export tank. As the War Office tanks grew ever heavier, Vickers came to realize that few foreign countries could afford them. Instead, they began developing a separate series of lighter mediums, designated by letters to avoid confusion with the British Army tanks, primarily for overseas sales. The Medium A was followed by the B-D until they finally got it right with the Medium E. The Medium E, universally known as the 6-tonner, was a reliable machine fully the equal of its foreign contemporaries. It was offered in two versions,



Left: Mk VI light tanks and carriers on maneuvers shortly before the war.

one with two machine gun-armed turrets and the other with a single larger turret with a Vickers short-barrel 47mm gun and coaxial machine gun. Although it was sold to quite a few countries, none of the sales were large. This was, however, sufficient to keep the Vickers works ticking over during an otherwise dry period in the early and mid-1930s.

In the meantime British tank design philosophy had changed significantly in ways that would effect their tank concepts for the next ten years. There were now to be two types of battle tanks. Infantry tanks would sacrifice speed for thick armor in order to support infantry attacking prepared enemy defenses, in the manner of the static warfare of the prior war. Medium (later called cruiser) tanks would be fast and would undertake the exploitation role and operate on the flanks. The specifications for both types of tanks were handed over to Vickers, where the lead designer would be Sir John Carden, Vickers having acquired the Carden-Loyd firm.

The initial cruiser requirement was the A9, which resulted in the Cruiser Mk I A9. The vehicle was a mix of some new componentry (the suspension, engine and 2pdr gun), some compromises in the name of cost and weight (very thin armor), and some truly anachronistic (twin subsidiary machine gun turrets). Within three months, this had been supplemented by a second specification, the A10, for a version of the A9 with thicker armor. This was accomplished by removing the subsidiary turrets and bolting extra armor plates over the front.

The infantry tank was the A11, and was clearly designed with price as the dominant criterion. A small, slow machine with a two-man crew and armed with only a single machine gun, it at least had a reliable engine and thick armor in its favor, although the former was probably due more to cost considerations than anything else.

The War Office ordered a small batch of Infantry Mk I A11 from Vickers in April 1937, and an even smaller quantity of Cruiser Mk I A9 four months later. At this point, however, things began to go awry.

Historians, particularly military historians, have often criticized the pre-war British governments for failing to recognize the threat of a resurgent Germany in time and failing to provide sufficient funding to build up defenses once the threat was apparent. There is certainly much truth to this, but it is also true that once money did start flowing, the War Office squandered much of it.

By 1937 there were two tank manufacturing plants in operation: Vickers at Elswick and ROF at Woolwich. The latter was being phased out of tank production in order to concentrate on weapons, but that same year Nuffield Mechanisation and Aero was established, with a modern production line for tanks. Money for the acquisition of cruiser and infantry tanks began to flow the following year. That money could have been used to expand the existing production lines and integrate the efforts of subcontractors, but instead it was used to place

contracts for small numbers of tanks with a wide variety of commercial heavy industries in order to "familiarize" them with the production of tanks. These contracts, typically for 40-50 tanks, were no incentive to create a modern production facility, but simply persuaded the firms and their component suppliers to adapt their existing facilities to low-level production of tanks. An inefficient system was born, one that would not only not improve during the first half of the upcoming war, but actually get worse.

The A9/A10 cruisers and A11 infantry tanks were regarded as interim vehicles even before the production contracts were signed. In the case of the cruisers the impetus for improvement came from observation of Soviet tanks using the American Christie suspension in 1936. A Christie tank was smuggled out of the US and examined with great interest and in short order Nuffield was given a contract to develop a cruiser tank using this new concept. The result was the Cruiser Mk III A13, which featured the same inadequate armor as the Mk I A9, but was faster, both on the roads and particularly cross-country. In 1939 it was decided that additional armor was required and, as with the A10, the answer was to bolt additional armor plates onto the hull and turret, this yielding the Cruiser Mk IV, also known as the A13 Mk2.

In the field of infantry tanks the inefficient Mk I was to be replaced by a larger tank, faster (although this was purely relative) and armed with a 2pdr gun in a 2-man turret. The basic design for this new Mk II was undertaken at Woolwich, and then handed off to Vulcan Foundry Ltd as part of the expertise-expansion program. Vulcan had already gained some experience in building Mk VI light tanks, but getting production running on this much heavier tank proved difficult. Although the first contract for 130 vehicles was placed in May 1938, none had been completed by the time war broke out and very few in the following year, despite the addition of three more firms with small contracts in August 1938.

In any event, a replacement for the Mk II Infantry was already on the drawing boards. The Valentine tank had been designed as a private



	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939 ^a
Armored Cars										
Crossley	8	-	-	-	-	-	-	-	-	-
Lanchester Mk IA	4	-	-	-	-	-	-	-	-	-
Lanchester Mk II	-	7	6	-	-	-	-	-	-	-
Morris CS9	-	-	-	-	-	-	-	99	-	-
Guy Mk I	-	-	-	-	-	-	-	-	100	-
Alvis-Straussler	-	-	-	-	-	-	-	-	12	-
Carriers										
Mk VI MG Carrier	257	-	-	-	-	-	-	-	-	-
Mk VIB MG Carrier	-	-	10	-	-	-	-	-	-	-
MG Carrier No.1 Mk1	-	-	-	-	-	-	14	-	-	-
MG Carrier No.2 Mk1	-	-	-	-	-	-	-	41	-	-
AOP Carrier	-	-	-	-	-	-	-	-	-	95
Cavalry Carrier	-	-	-	-	-	-	-	50	-	-
MG Carrier	-	-	-	-	-	-	-	741	210	-
Bren Carrier	-	-	-	-	-	-	-	-	1,301	-
Scout Carrier	-	-	-	-	-	-	-	-	667	25
Universal Carrier	-	-	-	-	-	-	-	-	-	2,276
Light Tanks										
Light Tank Mk II	16	-	-	-	-	-	-	-	-	-
Light Tank Mk IIA	-	29	-	-	-	-	-	-	-	-
Light Tank Mk IIB	-	21	-	-	-	-	-	-	-	-
Light Tank Mk III	-	-	9	33	-	-	-	-	-	-
Light Tank Mk IV	-	-	-	-	34	-	-	-	-	-
Light Tank Mk V	-	-	-	-	-	22	-	-	-	-
Light Tank Mk VI	-	-	-	-	-	51	-	-	-	-
Light Tank Mk VIA	-	-	-	-	-	-	210	-	-	-
Light Tank Mk VIB	-	-	-	-	-	-	30	416	468	-
Light Tank Mk VIC	-	-	-	-	-	-	-	-	-	167 ^b
Light Tank Mk VII	-	-	-	-	-	-	-	-	70	25
Medium, Cruiser & Infantry Tanks										
Medium Mk III	-	3	-	-	-	-	-	-	-	-
Cruiser Mk I (A9)	-	-	-	-	-	-	50	75	-	-
Cruiser Mk II (A10)	-	-	-	-	-	-	-	-	100	-
Cruiser Mk III (A13)	-	-	-	-	-	-	-	-	65	-
Cruiser Mk IV (A13 Mk2)	-	-	-	-	-	-	-	-	-	160
Cruiser Mk V (A13 Mk 3)	-	-	-	-	-	-	-	-	-	300
Cruiser Mk VI (A15)	-	-	-	-	-	-	-	-	-	100
Infantry Mk I (A11)	-	-	-	-	-	-	60	79	-	-
Infantry Mk II (A12)	-	-	-	-	-	-	-	-	230	441
Infantry Mk III Valentine	-	-	-	-	-	-	-	-	-	300

^a January-September

^b Taken from earlier Mk VIB contracts

Army & RAF Armored Vehicle Orders in the 1930s

venture by Vickers and was submitted to the War Office in February 1938, actually before the Mk II production contract was signed. Because it used so many components from earlier Vickers tanks, such as the suspension and engine from the Cruiser I and II, no prototype was built. Instead, an order for 275 was placed in July 1939.

The light tank saga is considerably simpler. Based on the earlier Carden-Loyd carriers, Vickers began developing a series of two-man light tanks armed with a single machine gun in the late 1920s. The Marks I to IV were all similar, but the Mark V introduced a two-man turret and twin machine guns (one .303 and one .5-inch) as armament. In addition to the

British Army (which split production between Vickers and ROF), Vickers also sold in small numbers to a significant number of overseas users. The definitive version was the Mark VI, which enlarged the turret to allow the radio to be moved there from the hull. By far the most common model was the Mark VIB, which saw large-scale service with the BEF and in the opening phases of the war in the desert. The final model of this tank, the Mark VIC, replaced the weak and unreliable .5-inch Vickers MG with the more powerful but even less reliable 15mm Besa.

The shortcomings of the light tanks, particularly the armament, was recognized even before the events in France in 1940 hammered it home. In 1937 Vickers designed an entirely new light tank, breaking completely with the earlier Mk I to Mk VI series. Armed with a 2pdr gun, the vehicle was ordered into production in July 1938 as the Mk VII Tetrarch. A total of 166 were ordered from Vickers and an additional 120 from Metro-Cammell. After the loss of the BEF, however, the army lost faith in light tanks, cancelling the Vickers order and reducing the Metro-Cammell order to 100, with the first being delivered in October 1940 and the last in March 1942. The tank was not issued to regular line units, but it was adopted by the airborne forces, who built the Hamilcar glider specifically to carry it. A few were used in the airborne drop in support of the Normandy invasion.

Other Prewar Vehicles

Due to the efforts of Sir John Carden and Vivian Loyd, the concept of the small two-man tracked vehicle gained its genesis in Britain and soon spread across the globe, where it was generally known as the "tankette". The Carden-Loyd firm developed an armored machine gun carrier through many prototypes in the 1920s and when it was acquired by Vickers Armstrong in 1928 the momentum gained through the marketing and facilities of the industrial giant paved the way for commercial success. The first practical version was the Machine Gun Carrier Mk VI as transporters for the heavy Vickers .303 water-cooled MG. The Army purchased about 250 from Vickers and another 57 built under license by ROF. Of more significance was the fact that small numbers were exported to a



JANE'S TANKS OF WORLD WAR II

large number of countries, some of whom (Italy, Poland and the Soviet Union) built variants themselves, with or without benefit of license.

As the war was to demonstrate the MG carrier, although inexpensive, had very little practical utility. The lack of room for a radio rendered it nearly useless as a scout, the limited traverse of the small weapon and the thin armor made it a questionable combat asset, and the provision for only one man (other than the driver) meant that in practice the weapon would rarely be dismounted. The British Army, unlike many of the others, recognized this early and the last deliveries came in 1933.

Vickers was not through with the concept of the carrier, however, and in 1934 they showed a new prototype which, when enlarged slightly, caught the interest of the War Office. Following prototype trials the MG Carrier No.2 was ordered into production. These new machines had room for a third crew member in the rear, facilitating dismounted use of the weapon, and room for a radio. Variants were developed, the most numerous of which was the Bren Carrier which featured improved armor and replacement of the Vickers gun by a Bren light MG and/or a Boys AT rifle. The Scout Carrier was intended for use with the divisional cavalry regiments and had two seats each side on the rear, facing outward. Finally, a variant was produced for use by artillery forward observers, the AOP carrier. Vickers was relieved of production responsibility for these vehicles after

the first batch of 41 in order to concentrate on tanks, and production was instead farmed out to Aveling Barford, Thornycroft, Sentinel Waggon Works and Nuffield. The MG carriers were used to form a carrier platoon in each infantry battalion, but once the Vickers guns had been removed from the infantry battalion structure, production switched to Bren carriers and many of the MG carriers were converted to that role.

The British were major proponents of armored cars through the 1920s. The majority of army and RAF vehicles were relatively light, based on the 4x2 Rolls-Royce chassis. Export vehicles were heavier, utilizing Crossley or Lanchester 6x4 truck chassis. Armament in all cases was limited to .303 machine guns, usually water-cooled Vickers guns. In the early 1930s, however, the Army lost interest in armored cars, preferring light tanks for the reconnaissance role. Development of armored cars essentially ceased from about 1934.

The Alvis firm teamed up with the Hungarian designer Nicholas Straussler in 1938 to market a 4x4 armored car called the Alvis-Straussler and the RAF ordered a dozen for use in the Middle East, but the Army refused to follow suit. Indeed, the foreign connection caused the War Office sufficient worry about security that they did not place any contracts for armored vehicle with Alvis through the rest of the war.

In the meantime, the Army was starting to reconsider its position on armored cars. A quick fix was attempted in 1937 with the purchase of

99 light armored cars from Morris, based on the 4x2 CS9 chassis, but with only single-axle drive, 7mm of armor, and armed with a Boys AT rifle and a Bren gun, these were clearly not a long-term answer. In fact, 15 of them were completed as armored command vehicles. A competition for a 4x4 armored car was held in 1938 and won by a vehicle based on the Guy "Quad-Ant" artillery tractor. The vehicle performed so well, in fact, that when the War Office placed the order in 1939, it was referred to as the "wheeled tank". To that end it shared the armament of the Mk VIB light tank.

Light Tanks

The poor showing the Mk VI light tanks convinced the Army that such vehicles were a waste of limited production resources. Some work continued at Vickers on evolutionary improvements to the Mark VII Tetrarch, and this resulted in the Mark VIII Harry Hopkins. Three prototypes were authorized in April 1941. Production was handed over to Metro-Cammell, which had previously built the Tetrarch, and the first vehicle was delivered in June 1943 and the last in March 1945, demonstrating the low priority assigned. All were placed in reserve, and none saw service.

The US M3-series light tank was used extensively in the Western Desert in 1941-42, but more in the role of a cruiser than a traditional light tank, where they proved popular due to their reliability. They continued to serve as gun tanks in Burma through much of the war, but by 1944 had been relegated to the scout role in the rest of the Army. They were assigned on the scale of one platoon (11 tanks) per tank and armored regiment, often suffering the indignity of having their turrets removed to better act as scout vehicles.

Cruiser Tanks

The Marks III and IV had proven the suitability of the Christie suspension for tanks and the time had now come to create a fully integrated tank using these elements. As part of the plan to diversify AFV expertise, design responsibility was handed over to the London, Midland and Scottish Railway (LMS), which had no prior

Left: A Comet tank approaches the Weser Bridgehead, April 1945.





experience at all. The result was, predictably, disastrous. The resulting tank, the Mark V Covenanter, was one of the best-looking tanks ever built, but could hardly ever be made to run reliably. In particular, it suffered from severe overheating problems that multiple modifications failed to cure. Production was undertaken by LMSR directly, and by English Electric and Leyland under LMS supervision. With the loss of the BEF the original contracts for 351 tanks were increased to 852 by September 1940. That should have been the end of it, but in early 1941 the number was doubled again to almost 1,700. The Ministry of Supply's seeming inability to say no to the multitude of producers they had intentionally spawned showed up again in their failure to stop production of a useless tank and the last of these machines was finally delivered in January 1943. Except for a few trials and bridge-laying vehicles, these tanks remained safely in the UK through the war.

The Covenanter undoubtedly represented the nadir of British tank development and production. Part of the problem was certainly the diffusion of effort, both in design and production, and the apparent inability or unwillingness of those responsible to enforce standardization and coherence of effort. In fact, during the first year of the war there were 16

firms building no fewer than 11 models of tank (counting the Light VIB/C as one). These were just the final assemblers; each had a network of suppliers for components and assemblies that sometimes overlapped with others, but often did not. Further, little thought appears to have been given to the need to upgrade vehicles over their service lives. The suspensions could rarely handle any additional weight and the turret rings usually prohibited the adoption of bigger guns. The slow climb back up was to start with the MkVI Crusader.

Nuffield's had been offered the opportunity to join the Covenanter production plan, but instead opted to develop its own, heavier, fast cruiser. The specification for this requirement was A15, and it called for commonality with the Covenanter to the fullest extent possible. Nuffield's wisely rejected the flat-12 engine of the Covenanter, as well as the forward placement of the radiators, although it retained the Christie suspension and the overall appearance. The result was the Cruiser Mark VI Crusader. Initial trials showed it to be more reliable than the Covenanter, but exactly how faint this praise was would not show up until they were sent to the desert in mid-1941. There they suffered greatly from sand ingestion and, although fast, they soon became unpopular for their habit of breaking down.

The Crusaders I and II with their 40mm 2pdr guns were undergunned by early 1942, but help was slow in arriving. The 57mm 6pdr gun program had been initiated in April 1938, but it was not until early 1940 that the first gun was available for testing. The decision to mount the larger gun in the Crusader (the first cruiser capable of handling it) was made in May 1941 but work on the turret proceeded with little apparent urgency and the version finally chosen was little more than a reworked 2pdr turret, with one crewman lost to make room for the larger gun. Thus, the commander also had to assume the duties of gunner, to the detriment of both. The first production order for the Crusader III was not placed until December 1941, with deliveries beginning in May 1942. Thus, within about six months or so, it too would be undergunned in comparison to its foes.

The need for a 6pdr-armed cruiser had been foreseen as early as mid-1940. The Department of Tank Design drew up specifications that, in January 1941, yielded two possible approaches. Nuffield proposed their Crusader but with a purpose-built turret for the larger gun, drawing initial favorable reaction and permission to proceed with six prototypes as the A24. Birmingham Railway Carriage & Waggon proposed a new tank (although retaining the

	Light Tanks			Cruiser Tanks				Infantry Tanks				
	Mk VIB	Mk VIC	Mk VII	Mk I	Mk II	Mk III	Mk IV	Mk V	Mk VI	Mk I	Mk II	Mk III
Birmingham Car Co.					73							14
Crabtree						(A)						
English Electric												
Foden												
Harland & Wolff												
J. Fowler	45	34										
Leyland												
L.M.S.												
Metro Cammell												
N.B. Locomotive	39											
Nuffield Mech & Aero												
Ruston & Hornsby	14	39										
Vauxhall Motors												
Vickers Armstrong	43	55	(A)	50	10							
Vulcan	31	38										
West Gas Imps												
(A) on order, but none yet completed												

Tank Production by Firm, September 1939 to September 1940



JANE'S TANKS OF WORLD WAR II

	Prior	1939 ^a	1940	1941	1942	1943	1944	1945 ^b
Light Tanks								
MKVII, VIA & VIB	1001	173	0	0	0	0	0	0
MK VIC	0	7	160	0	0	0	0	0
Mk VII (Tetrarch)	0	0	15	68	12	0	0	0
Mk VIII (Harry Hopkins)	0	0	0	0	0	33	58	9
Cruiser Tanks								
Mk I (A.9)	41	35	49	0	0	0	0	0
Mk II (A.10)	0	1	159	11	0	0	0	0
Mk III (A.13)	43	22	0	0	0	0	0	0
Mk IV (A.13 Mk II)	0	8	256	6	0	0	0	0
Mk V (A.13 Mk III) (Covenanter)	0	0	7	762	957	27	0	0
Mk VI (Crusader) 2pdr/3" How	0	0	2	655	1342	0	0	0
Mk VI (Crusader) 6pdr	0	0	0	0	907	771	0	0
Mk VII (Cavalier)	0	0	0	0	0	161	0	0
Centaur 6pdr	0	0	0	0	2	1037	22	0
Centaur 75mm	0	0	0	0	0	160	73	0
Centaur 95mm How	0	0	0	0	0	64	50	0
Cromwell III	0	0	0	0	0	39	0	0
Cromwell 6pdr	0	0	0	0	1	334	23	0
Cromwell 75mm	0	0	0	0	0	220	1604	46
Cromwell 95mm How	0	0	0	0	0	0	308	33
Challenger	0	0	0	0	0	0	145	56
Comet	0	0	0	0	0	0	143	984
Infantry Tanks								
Mk I (A.11)	65	41	33	0	0	0	0	0
Mk II (A.12)(Matilda)	0	24	356	1038	1330	143	0	0
Mk III (Valentine) 2pdr/3" How	0	0	345	1621	1683	429	0	0
Mk III (Valentine) 6pdr	0	0	0	0	256	1102	35	0
Mk IV (Churchill) 2pdr/3" How	0	0	0	690	734	0	0	0
Mk IV (Churchill) 6pdr	0	0	0	0	966	1258	73	0
Mk IV (Churchill) 75mm	0	0	0	0	0	6	809	531
Mk IV (Churchill) 95mm How	0	0	0	0	0	61	180	171
(of the Churchills, heavy model)	0	0	0	0	0	[6]	[567]	[702]
Specialized Variants								
Crusader Hulls ^c	0	0	0	0	0	898	0	0
Crusader Bofors AA	0	0	0	0	0	214	0	0
Crusader OP	0	0	0	0	0	112	0	0
Cavalier OP	0	0	0	0	0	158	182	0
Centaur Hulls ^d	0	0	0	0	0	0	352	23
Valentine Hulls ^e	0	0	0	0	0	102	0	0
Conversions								
Covenanter Bridgelayer	0	0	0	0	69	26	0	0
Crusader Oerlikon AA	0	0	0	0	0	204	294	0
Crusader Tractor	0	0	0	0	0	0	474	126
Cavalier OP	0	0	0	0	0	123	0	0
Centaur Polsten AA	0	0	0	0	0	0	95	0
Centaur Bulldozer	0	0	0	0	0	0	0	250
Valentine Bridgelayer	0	0	0	0	42	174	24	9
Churchill 2pdr to 6pdr	0	0	0	0	153	505	0	0
Churchill 6pdr to 75mm	0	0	0	0	0	0	1339	446
Churchill AVRE	0	0	0	0	0	0	593	52
Churchill Bridgelayer	0	0	0	0	0	0	44	22
Sherman OP	0	0	0	0	0	60	43	0
Sherman 17pdr	0	0	0	0	0	0	1783	563
Sherman Flail (Crab)	0	0	0	0	0	6	417	224
Sherman ARV	0	0	0	0	0	0	53	0
Ram GPO	0	0	0	0	0	0	0	350
Ram ARV	0	0	0	0	0	0	0	34

^a Sept-Dec only^b Jan-Sept only^c for later conversion to Oerlikon AA^d for later conversion to for Polsten AA^e for later conversion to bridgelayer

Christie suspension), to which they later added the Rolls Royce Meteor engine. This received a somewhat cooler reception.

Trials in late 1941 and early 1942 showed the A24 to be seriously flawed, in particular it was even less reliable than the Crusader. Nuffield's promised improvements, but it seemed likely that there was little room left in the old Crusader lineage. Attention now turned to the BRW&C proposal. In the meantime Leyland had taken a look at the design and come up with their own variant, using the thoroughly familiar (if increasingly underpowered and unreliable) Liberty engine, rather than BRW&C's more radical adoption of the powerful Rolls Royce Meteor.

Predictably, the Ministry of Supply let all three suppliers have their way. The A24 would enter production as the Cruiser VII Cromwell I, the Leyland vehicle as the A27L (for Liberty) Cromwell II, and the BRW&C vehicle as the A27M Cromwell III. In November 1942 this confusion was cleared up slightly by renaming the A24 as the Cavalier, the A27L as the Centaur, and the A27M as the Cromwell.

The Cavalier, not surprisingly, suffered from many of the reliability problems of the Crusader on which it was based and few were built, none used in combat. The Centaur still used the old Liberty engine of the Crusader and its reliability suffered as a result, but featured the upgraded suspension developed by BRW&C as well as the Merrit-Brown gearbox and was thus a sort of interim step in the development of the new-generation cruiser. They served for the most part as training vehicles, although about 80 armed with the 95mm howitzer were used by the Royal Marines in the opening phases of Normandy.

The Centaur had the distinction of being the first cruiser model with a 75mm gun, although only beating the Cromwell by a few days. Once again, the tank designers had been caught behind the curve, with turrets and turret rings developed for the 57mm 6pdr and incapable of accepting anything larger. After several abortive attempts to develop a gun, Vickers engineers realized they could simply rebore and re chamber the existing 6pdr and turn it into a 75mm gun that fired the same ammunition and with the same (mediocre) results as achieved by the American 75mm M3 gun. The new weapon would, obviously, fit into a

British Wartime Production of Tanks & Variants



6pdr mounting and starting in October 1943 Centaurs and Cromwells began coming off the line with this weapon.

The transition to the next-generation cruiser was completed (although not perfected) by the Cromwell. The excellent Meteor engine gave the vehicle high speed and the beefed-up Christie suspension provided both good cross-country mobility and the ability to absorb additional weight later on. Although still not as reliable as the Sherman, it was a great improvement over the previous cruisers and proved a serviceable tank.

The one thing Cromwell did not have was an effective main armament. A perfectly good weapon had been developed in the form of the 76mm 17pdr and had entered production as a towed anti-tank weapon in mid-1942. Unfortunately, the Cromwell, which was to be the tank of the future, could not carry this weapon, as its hull was too narrow. Thus, BRW&C was asked to develop a Cromwell variant suitable for mounting this new gun. They widened the center section of the hull (but not the distance between the tracks), lengthened it and added an extra roadwheel to accommodate the weight, and replaced the turret with a high, slab-sided welded unit. Even so, the turret frontal armor had to be reduced, along with the hull side armor, and the vehicle proved difficult to drive due to its length. In February 1943 200 Challengers were ordered but in November the decision was made to halt production once those had been completed.

If the 17pdr could not fit into the Cromwell without ruining the tank's integrity, then one obvious alternative was to modify the gun. Vickers had been working on a high-velocity 75mm L/50 gun since March 1942. This had originally been planned for the Cromwell, but in May 1943 it was discovered that it would not fit after all. Nevertheless, work continued and in October it was announced that the gun would be modified to fire 17pdr ammunition and it was redesignated the 77mm gun to avoid confusion with others. Now it just remained to design a new tank to take this weapon. This was handed over to Leyland, who made the maximum possible use of Cromwell

components. The result was the Comet, the ultimate development of the British cruiser.

With the Comet, the tank designers had finally come up with a winner. After a tortuous process and not a few two-steps-forward-one back, the British Army finally had a medium tank as good as any in world. Unfortunately, they did not start coming off the production line until September 1944. Four firms were brought into the production effort, but output did not reach 100/month until March 1945. They were issued to the troops only after the Rhine crossing.

The provision of separate tank types for the normal armored exploitation role and for infantry support had been seen as wasteful of design, development and production assets. The A10 seems to have attempted to answer both requirements, but finally fell firmly into the cruiser category. The Valentine tried to do both, and wound up doing neither terribly well. Yet the quest for a "universal tank" continued. In November 1943 the requirement A41 was issued and responsibility was handed over to the Ministry of Supply's Department of Tank Design, their first such program since the war began. The Department probably should have been given this responsibility earlier, for the results were impressive. Six prototypes of the new vehicle, christened the Centurion, were running trials when the war ended in Europe.

Infantry Tanks

At the start of the war the Marks I and II were in production and the Mark III Valentine on order. The Valentine, which was to bear much of the burden of the war for the next two years, came off the production line at Vickers fairly quickly, due to the use of components from earlier tanks. The parent firm delivered the first eight in June 1940, by which time orders already totalled 1,729 from four firms. Since they were more thinly armored than previous infantry tanks, but slightly faster, they were often used as cruisers during 1941. They were upgunned twice during their lives, first to 6pdr and then to 75mm, but both required sacrificing one of the turret crew, with the attendant inefficiencies.

Both the Matilda and Valentine remained in production in the UK well into 1943, the Matilda being valued for its thick armor and the Valentine for its all-around utility. The Valentine was also produced in Canada, but for shipment to the Soviet Union rather than for British use.

In the meantime, a true successor to the thick-skinned Matilda was under consideration. An initial effort, known as the A20, ran in prototype form in June 1940 but proved a failure. With their tank force all but wiped out, and facing imminent invasion, Vauxhall was asked to take the A20, scale it down a little and



Right: Valentines fitted with Duplex Drive and flotation screens (here lowered).



Left: A Churchill AVRE in France, September 1944. The demolition launcher that replaced the gun could throw an 18-kg bomb 70 meters.

a later model when that became available. The British M3 had slightly thicker armor and a new cast turret, bulged in the rear to accommodate the No.19 radio and with a simple two-piece hatch replacing the cupola used by the US models.

The contract was mooted when Lend-Lease became available. The first Lend-Lease bill authorized the transfer of tanks off the production line under US Army contracts to Britain, and 1,271 M3 mediums and 1,250 M3 lights were diverted. Subsequently, Lend-Lease purchases were simply incorporated into the US War Department procurement plans. It quickly became clear that in order to get delivery of M3 mediums as soon as possible, it would be necessary to accept the original American version as well as their own. Thus, the British distinguished between the M3 Lee (American) and M3 Grant (British) tanks.

As anticipated, procurement switched to the M4 Sherman as soon as that became available, with the first major batch, 354 M4A2, being delivered in August 1942. The majority of these were the A2 and A4 versions, but all models

get in into production as quickly as possible. The result was the A22, later called the Churchill. An order for 500 was placed right off the drawing board and deliveries began in June 1941.

Not surprisingly, given the lack of development models, the initial batches were miserably unreliable. Modifications and fixes were applied in a massive program to make the tank "right" over the next year and by the time it was committed to action in Tunisia it had evolved into an effective and reliable machine. They proved exceptionally useful in difficult terrain. Although heavier than a Sherman, their wider tracks yielded a lower ground pressure that enabled them to cross soft ground that caused the M4 to bog down, while their controlled differential steering allowed them to pivot turn, something US tanks at the time could not do.

In fact, the Churchill was so successful that initial plans to halt production in 1943 were shelved and they were still being turned out in September 1945.

United States Tanks

Little thought appears to have been given to purchasing tanks in the US until the summer of 1940. A British Purchasing Commission had been set up earlier, but this concerned itself mostly with coordinating Canadian production. In July 1940 a British Tank Mission (the Dewar Mission) arrived to attempt to persuade American factories to produce A12

Matildas and A15 Crusaders for Britain.

The American insistence on standardization with American designs thwarted this, but they were shown the M2A4 light tank and a mock-up of the M3 medium tank. Neither was a particularly good combat vehicle, but both were reliable. A contract was placed almost immediately for 3,000 M3 mediums, with two provisos: (1) they be modified to British requirements and (2) production be switched to

	1941	1942	1943	1944	1945
Light, M2A4	36	-	-	-	-
Light, M3	736	1,039	59	-	-
Light, M3A1	-	548	1,046	-	-
Light, M3A3	-	-	1,520	525	23
Light, M5A1	-	-	3	1,128	300
Light, 22	-	-	57	203	160
Light, M24	-	-	-	164	125
Medium M3 Grant	229	1,522	-	-	-
Medium M3 Lee	-	900	252	-	-
Medium M4 (75mm)	-	4	190	2,154	90
Medium M4 (105mm)	-	-	-	438	21
Medium M4A1 (75mm)	-	264	121	563	-
Medium M4A1 (76mm)	-	-	-	1,259	71
Medium M4A2 (75mm)	-	385	4,153	489	14
Medium M4A2 (76mm)	-	-	-	-	5
Medium M4A3	-	1	6	-	-
Medium M4A4	-	129	5,392	1,632	7
Medium M4E8 (105mm)	-	-	-	53	81
Medium M4 Tank Dozer	-	-	-	124	40
Medium, M26E3	-	-	-	-	6
Recovery Vehicle M32	-	-	-	24	110

US Tank Exports to the Commonwealth



	1941	1942	1943	1944	1945
Light Tanks					
UK	140	5	685	1,611	306
Middle East	582	239	637	-	-
Persia/Iraq	-	169	46	-	-
North Africa ^a	-	-	522	407	-
Medium Tank					
UK	62	287	5,616	4,664	316
Middle East	167	1,213	1,965	-	-
Persia/Iraq	-	30	80	-	-
North Africa ^a	-	-	1,767	1,703	81
Gibraltar	-	-	10	-	-

^a North Africa served as a staging area for Italy
note: does not include other Empire shipments

Destinations of US Tank Shipments

were represented. To distinguish among them the British styled them the Sherman I (M4), II (M4A1), III (M4A2), IV (M4A3), V (M4A4). The suffix "A" was used to designate a 76mm-armed vehicle.

One major change made to the Sherman was the retrofitting of the 17pdr gun. By late 1943 it had become obvious that the only way to get large numbers of 17pdr-armed tanks into the field was to use the Sherman. A conversion kit was developed, but it turned out that not all Shermans could be regunned. In order to be amenable to the conversion a Sherman had to have (a) a gasoline engine, (b) a wide mantlet, (c) hydraulic traversing gear, and (d) M34A1 gun mount. These features were not unique to any particular model of Sherman, indeed some batches in all gasoline-powered models could incorporate them, but not all did. This led to the vexing problem that, although they had been notified how many of each model were being shipped, the Ministry of Supply did not know until they had actually inspected the arriving tanks, how many could be converted – certainly an impediment to planning.

The ROF was issued a contract in December 1943 for the conversion of 2,100 Sherman Vs to 17pdr configuration as the "Firefly", but in fact other models were eventually used as well. The conversion involved not only the fitting of the new gun, but also opening a hole in the turret rear so that the radio could be moved back to avoid the recoiling gun, and elimination of the hull gunner position in favor of ammunition stowage. Although not an entirely elegant solution, the Firefly did rectify the one major

shortcoming of the Sherman, lack of firepower, and was thus greatly welcomed.

Of course, not all the tanks were shipped directly to Britain. During the first two years of the program the majority of tanks destined for British forces (and those directly under its control) went to the Middle East. After that, a substantial portion went to Italy, where British cruisers were not used.

Tank Destroyers and Assault Guns

The first British tank destroyer resulted from an urgent request in September 1941 for vehicles capable of engaging heavy German tanks. One solution was to take 3" AA guns, rendered surplus by the introduction of the 3.7" gun, and mount them in fixed superstructures on Churchill chassis. A prototype was completed in February 1942 and an initial order for 24 was increased to 100 then reduced to 50.

Production was a trickle, exceeding seven in a

month only once, in February 1943. The resultant vehicle, officially known as the Mk I Gun Carrier, 3" Gun, Churchill, was well armed, but lacked a machine gun, was slow and unreliable, and had a tall vertical face that did nothing to complement the 88mm thick frontal armor. They never saw combat and most were later converted to trials vehicles for specialized equipment.

Although the Churchill Gun Carrier was never intended for mass production the ongoing difficulties in fitting an effective gun to British tanks highlighted the continuing need for an armored vehicle capable of defeating German armor. The only solution visible in the short term was the American M10-series tank destroyer, essentially a Sherman tank with an open-topped turret mounting a medium-velocity 3-inch gun. Over 1,600 were acquired with the designation "Wolverine" and issued to the RA's anti-tank regiments. As production of the 17pdr gun ramped up it proved possible to regun the Wolverines with that weapon. When rearmed the vehicles were known as the Achilles Mk IC (M10) or Mk IIC (M10A1). In fact, the Wolverines delivered in 1944 arrived without armament, as this reduced cost. The majority of the Wolverines were so converted, 1,127 by factories and depots, and a further 262 in theaters with kits. Those not converted had their turrets removed for use as gun-towing vehicles. The Achilles proved a popular weapon and remained in service for several years after the war.

In the meantime, efforts had begun to mount the powerful gun on the chassis of a British tank. An initial examination of the Crusader showed it

	1941	1942	1943	1944	1945 ^a
Production					
3" 20cwt Churchill	-	26	23	-	-
17pdr Archer	-	-	-	354	307
17pdr A.30 Avenger	-	-	-	-	25
95mm Alecto	-	-	-	-	45
Conversions					
M10 to 17pdr	-	-	-	986	403
Imports					
3" M10/M10A1	-	5	1,123	-	-
3" M10/M10A1 (less gun)	-	-	-	520	-

^a January-September

Deliveries of Tank Destroyers & Assault Guns



JANE'S TANKS OF WORLD WAR II

to be too small and underpowered for the role and attention turned to Valentine. At first, consideration was given to adopting the arrangement of the Bishop SP 25pdr, but this quickly proved impractical. Instead, a contract was given to Vickers to develop a new vehicle using the chassis of the Valentine as the basis. The resultant vehicle was given the official title of SP 17pdr Valentine, although it was usually referred to as the Archer. The first of the series production vehicles came off the Vickers line in April 1944 against an order for 800, although the end of the war terminated production before the contract was completed. The vehicles were issued to the anti-tank battalions of the British armored divisions from October 1944 onwards.

The final tank destroyer to enter production was the A.30 Avenger. It was a modified A.30 Challenger tank altered to meet the requirements of the Royal Artillery anti-tank branch. Both the hull sides and turret were reduced in height, yielding a vehicle 56cm lower than the tank. The coaxial machine gun was dispensed with, as was the roof armor, the latter replaced by a mild steel cover carried slightly above the turret top. Altogether a better looking vehicle than the Challenger, it possessed no real advantage over that vehicle other than its reduced height and little priority was given to its production. As a result, the order for 230 vehicles was not completed until 1946 and the vehicle saw no combat service.

The sole British assault gun was the Alecto. A General Staff Requirement issued in April 1942 called for a light SP infantry gun that could give close support to the infantry in an attack. The solution was to mount the 95mm howitzer (a variant of the tried-and-true 3.7" howitzer) in the hull of a turretless Mk VIII Harry Hopkins light tank. In May 1943 the contract with Metro-Cammell for the near-useless Hopkins tank was modified to read only 100 tanks, with the remaining 1,100 to be completed as Alectos. Shortly thereafter, however, the infantry lost interest and the contract was reduced to 300 Alectos, these to be used by the support troops of the armored car regiments to replace the 75mm half-tracks and ungainly AEC Mk III armored cars. This was a low priority, however,

Right: An RAF Crossley armoured car in Aden, 1939.

	1941	1942	1943	1944	1945
Production					
Bishop 25pdr	-	137	13	-	-
Imports					
M7 Priest 105mm	-	497	335	-	-
Sexton 25pdr	-	-	146	1,220	n/a

Deliveries of Self-Propelled Artillery

and few were completed before the war ended and none saw combat.

Self-Propelled Artillery

The formation in the late 1920s of a battery of SP Birch guns led nowhere and when the war broke out Britain, like every other country, had no self-propelled artillery. The mobile fighting in the Western Desert quickly brought home the need for such weapons and in June 1941 Middle East Command urgently requested a self-propelled 25pdr weapon. Birmingham Railway Carriage was asked to quickly produce a prototype using the chassis of the Valentine as a basis and the vehicle, christened the Bishop, was ready for firing trials in August. A contract for 100 vehicles was placed in November and deliveries began early in 1942. In July a contract for a further 50 vehicles was placed and the last

of these was delivered in January 1943.

The extemporized nature of the Bishop conversion was readily apparent and when the American M7 SP howitzer became available, Lend-Lease contracts were placed for over 2500 vehicles, although these were never completely filled. With deliveries to Britain starting in June 1942, these vehicles served well and the Bishops were quickly retired, but their 105mm howitzer was not a standard weapon of the British Army and a substitute was sought. The solution came from Canada, where they had taken their Ram and Grizzly tank chassis and created a conversion similar in configuration to the M7, but using the 25pdr gun-howitzer. About 1500 of these vehicles, known as the Sexton, were acquired by Britain, and they replaced the M7s in service (except in Italy) and became the Army's standard SP artillery.





Armored Cars

The need for four-wheel drive armored cars had become clear by the late 1930s, but it was not until 1938 that the first trials of such vehicles were conducted. Morris submitted a design based on the work of Straussler, while the Guy proposal used the chassis of their Quad Ant artillery tractor with the engine moved to the rear. The Guy won convincingly and an order was placed for 101 vehicles under the unusual designation Guy Wheeled Light Tank. They tended to overheat in the desert, and were unreliable elsewhere, but the 38 available by May 1940 were all the modern armored cars the British had. A few were sent to mainland Europe with the GHQ Liaison Regiment, where five were lost in the evacuation. The main contribution of the Guy was the development at the factory of a rotary jig that held the body and moved it about to provide quick, easy access for the welder.

With the start of the war, large quantities of armored cars were suddenly needed. Guy was too busy with other war work to continue production, a fortuitous circumstance as it turned out. Instead, attention turned to the Rootes Group, whose Karrier subsidiary was building their KT4 all-wheel drive tractor for the Indian Army. Moving the engine to the rear, as Guy had done earlier with their chassis, allowed the Guy Mk IA body to be dropped on quite neatly. Guy built a further 140 hulls for use on the new armored cars, now called Humber Mk I. The new chassis proved rugged and reliable and the Humber turned out a much better vehicle than the earlier Guy. For the Mk II the hull was redesigned with a modified driver's position that made production easier and made his compartment a bit roomier. The Mk III version had a larger 3-man turret, but the same inadequate armament. Finally, that issue was addressed with the Humber Mk IV, the first of which was delivered in December 1942, about a month behind schedule. This featured a new turret that mounted an American 37mm tank gun and a coaxial 7.92mm Besa.

Meanwhile, Daimler had been working on their own design for an armored car. For this they drew on the BSA/Daimler scout car, and adopted the unibody hull, although not the troublesome four-wheel steering. A fluid

	1939a	1940	1941	1942	1943	1944	1945
Production							
Armored Cars							
Guy	-	101	-	-	-	-	-
Humber (15mm)	-	-	657	873	-	-	-
Humber (37mm)	-	-	-	150	1,686	282	-
Daimler	-	-	135	721	586	653	500
AEC (2pdr)	-	-	-	119	-	-	-
AEC (6pdr)	-	-	-	-	293	7	-
AEC (75mm)	-	-	-	-	-	200	-
Coventry	-	-	-	-	-	63	220
Scout Cars							
Daimler	22	561	1,071	1,574	1,528	1,302	511
Humber	-	-	-	-	1,257	2,775	266
Light Reconnaissance Cars							
Humber ^b	-	198	348	2,223	830	-	-
Morris ^b	-	0	0	957	508	206	-
Beaverettes	-	2,250	-	-	558	-	-
Imports							
Armored Cars							
Canadian GM (.50cal)	-	-	-	276	841	6	-
T17E1	-	-	-	157	2,687	-	-
T17E2 (AA)	-	-	-	-	-	999	-
T18E2	-	-	-	-	30	-	-
M8	-	-	-	-	6	494	-
Marmon-Herrington IV	-	-	-	348	1,355	413	-
Scout Cars							
Canadian Ford	-	-	-	902	1,407	761	185
M3A1 Scout Car	-	-	-	23	6,584	621	-

^a September-December only
^b War Office (army) only

Wartime Deliveries of Armored Cars & Scout Cars

flywheel linked the engine to a preselector gearbox, thence by four separate shafts to the wheels, which were individually mounted on the hull. For the first time a British armored car was given a cannon armament, in the form of a 2pdr gun in a turret similar to that of the Tetrarch light tank. Following successful trials a thousand vehicles were immediately ordered. Deliveries began in May 1941. The original Daimler armored car was followed by the Mk II which featured a range of minor improvements, such as two-speed dynamo and modified gun mounting.

The largest armored car was built as a speculative venture by the AEC company. They took their Matador medium tractor and, as Rootes had done, moved the engine to the rear to accommodate an armored body. Bulky and heavy, the AEC Mk I had thicker armor than the earlier armored cars and 122 were

ordered in June 1941. The turrets came from Valentine I tanks being converted to bridgelayers. Some were shipped to North Africa, where they were used mostly for convoy escort. It must have seemed a shame to waste such a large, heavy vehicle to carry a 2pdr gun, so design work was begun on a 6pdr version. The result was the Mk II, with a redesigned hull and a different turret with a 6pdr and a 7.92mm Besa. The Mk II saw service in Italy starting in late 1943. The next step was a logical one, replace the 6pdr gun with a 75mm gun to yield a heavy armored car. Production was limited to 200 vehicles, however, because the armored car regiments were already equipped with the US M3 75mm half-track vehicle for the fire support role and were quite happy with it.

The culmination of British armored car development was to be the Coventry, developed



JANE'S TANKS OF WORLD WAR II

jointly by Humber and Daimler. Not surprisingly, it combined features from both of the producers' armored cars. It had a shape most closely resembling the Daimler, but went to a more conventional suspension/drive system, with axles driven by two drive shafts. Two variants were planned, the Mk I with a three-man turret and a 2pdr gun, and the Mk II with a two-man turret and a 75mm gun. Deliveries of the Coventry Mk I began at a slow rate in June 1944 and were planned to replace both the Daimler and Humber armored cars on the production lines. They did, in fact, replace the Humbers at that plant, but the Daimlers had proven so popular that there seemed no point in accepting the inevitable break in production, so Daimler was contracted to keep on building its own vehicle.

Significant quantities of armored cars were also acquired from the US, particularly the T-17E1, known as the "Staghound" in British service. Large vehicles, armed with only a 37mm gun, they were nonetheless prized for their roominess as a command vehicle and ease of operation. A small number were fitted with the turrets from Crusader III tanks refitted with 75mm guns to create a fire-support armored car.

Although the type was not adopted by any other army, the scout car proved very popular in British and Commonwealth service. It is unclear when the requirement for a 4-wheel drive, lightly-armored, 2-man vehicle was promulgated, but trials with four competing designs were held in 1938. Two vehicles showed promise, one by BSA and the other by Alvis, and these two were modified and retested in 1939. The BSA design was selected and placed in production by Daimler (who had acquired BSA in the interim).

With the fall of Dunkirk very few armored vehicles remained in Britain. A crash program to produce protected vehicles was embarked on. The vehicles were usually protected, rather than armored, for they almost invariably used mild steel or, in some cases, concrete or enclosed gravel, rather than armor plate as the basis of their protection. The most common were the Beaverettes Mk I and II and the Humberette vehicles, based on automobile chassis. The initial batch of the Beaverette Mk I was followed by orders totalling 800 of the Mk II version, 460 for the army and 340 for the Ministry of

Aircraft Production for defense of aircraft factories, presumably against parachute raiders). A somewhat smaller number of Humberettes were also built when supplies of armor plate became available. Most of the army vehicles were transferred to the RAF for airfield defense after 1940. The Beaverette Mk III featured a turret with a Bren gun or two Vickers MGs and was protected by 10mm armor for its crew of three. In August 1941 a contract was placed for a thousand of these vehicles by the RAF for airfield defense to replace the Beaverette Is and this was completed in late 1942.

An outgrowth of this hurried development was the emergence of the "light reconnaissance car". These were somewhat better-designed vehicles with more conventional AFV bodies, but the initial models, such as the Humber Ironsides I and II and the Morris I still used the 4x2 drive system. The Humber III and Morris II introduced four-wheel drive, which made them more useful, and these models were used by the reconnaissance regiments of the infantry divisions to the end of the war. About 600 Morris reconnaissance cars were also used by the RAF for airfield defense.

Anti-Aircraft Vehicles

The effectiveness of the Luftwaffe, especially on Allied morale, was a shock to the War Office. As an expedient solution a turret was developed with four 7.92mm Besa MGs and fitted to the chassis of the Light Tank Mark VIA in 1940 as the AA Light Tank Mk I. This was succeeded by the AA Light Tank Mk II, which had a roomier turret with improved sights and utilized the Light Tank Mk VIB chassis. These were clearly far from optimal and only about 50 were converted.

Efforts then turned to mounting more substantial weapons on the chassis of cruiser tanks. The first to reach fruition were those based on the Crusader. Two versions were planned, one with a single 40mm Bofors gun and the other with a turreted twin 20mm Oerlikon. The former utilized a variant of the field mount, with either half- or full-around armored shield and so was cut into the production line quickly, the first being delivered in February 1943 as the Crusader AA Mk I. Development of the twin Oerlikon turret ran into delays, however, and the Crusader hulls had to be put into storage until turret deliveries

began in June. Although 900 Oerlikon Crusader AA Mk II were envisioned, and the hulls built, by mid-1944 the need had diminished and the program was curtailed at about 500 vehicles. The second effort involved finding a use for Centaur chassis that were otherwise unwanted. The result, the Centaur AA, used the same turret as the Crusader AA II but with Polsten 20mm guns in lieu of the Oerlikon models. Once again the delivery of turret lagged behind that of the chassis and in the end the program was stopped before completion.

The most numerous AA vehicle was the M14, the M3 half-track with the Maxson twin .50cal turret. The US delivered 1,622 of these vehicles between April 1943 and March 1944. After delivery the turrets were removed from the vast majority of them and they were used as general purpose armored vehicles.

There was also a program to mount the quad 7.92mm Besa turret on the Humber armored car, but few of these appear to have been built. Instead, almost a thousand T17E2 AA armored cars were acquired from the US via Lend-Lease, although they seem to have been little used.

Carriers

Even before the outbreak of the war it was recognized that the production of four separate types of carrier, the MG, Bren, Scout and Cavalry, was wasteful. A standardized vehicle was needed and the result was the Universal Carrier. Each infantry battalion received a platoon of four sections each of three carriers – one with a Bren gun, one with a Bren gun and an AT rifle (later a PIAT), and one with a Bren gun and a 2" mortar. Two variants of the Universal carrier were also developed. The mortar carrier was also issued to the infantry battalions, two vehicles for each 3" mortar, and differed from the standard in stowage arrangements. The AOP carrier was developed for artillery forward observers.

The armored carrier was a uniquely British invention. No country outside the Commonwealth adopted such vehicles, feeling that the costs and (more importantly) logistical burden of tracked armored vehicles of such limited payload made them inefficient. Nevertheless, they were popular with the British Army, which retained them in service into the 1950s.



Not all roles required an armored vehicle and to this end the Loyd carrier was developed. Slightly larger than the Universal Carrier, it was used to tow anti-tank guns, carry battery charging equipment, lay wire for communications and a variety of other tasks.

To fill Commonwealth requirements contracts were also placed overseas. Larger versions of the Universal were built in Canada as the Windsor Carrier and in the US as the T16. The US vehicle dispensed with the warp-steering used in the Universal in favor of a simple clutch-and-brake. Both vehicles proved useful for carrying the 4.2" mortar and towing the 6pdr AT gun due to their larger size.

	Prior	1939 ^a	1940	1941	1942	1943	1944	1945 ^b
British Production								
Carrier, Bren	2,346	245	1	-	-	-	-	-
Carrier, Scout		331	-	-	-	-	-	-
Universal (Bren)	1,874	611	4,955	6,906	4,193	6,489	6,890	1,818
Universal (3" mortar)	-	-	-	493	6,879	5,084	663	1
Universal (AOP)	-	-	196	645	2,160	2,415	1	-
Loyd	-	-	184	618	2,648	4,878	9,721	46
US Production								
Carrier, T16	-	-	-	-	-	4,693	8,200	604

^a September-December only

^b January-September only

Wartime Production of Carriers

Below: A universal carrier enters Uelzen on 23rd April 1945.





Light Tanks, Marks I to V

These tanks were developed by Vickers from the Carden-Loyd carriers. The Mks I-IV were all armed with a single machine gun (usually .303, but sometimes the .5-inch Vickers in the Mk III and IV) and had one-man turrets. The Mk II established the configuration for the later vehicles, with the powertrain on right and turret slightly to the left. The Mk IV dispensed with the frame, using the hull as the chassis. Similar vehicles were widely sold by Vickers with commercial designations. The Mk V introduced a 2-man turret and twin machine guns (one of each type). Although fast, their thin armor made them very vulnerable, their armament was weak and their short length caused them to pitch violently over rough ground, although this was slightly less noticeable on the longer Mk V. Obsolete by 1939, none of these earlier marks were sent with the BEF, although a few served briefly in North Africa.

Mk V light tanks on maneuvers, 1939 (TMB)



	Weight (tonnes)	3.83	Front Armor (mm)	12
	Length (m)	3.40	Side Armor (mm)	9
	Width (m)	1.30	Engine HP	88
	Height (m)	2.12	Road Speed (km/h)	60

Light Tank, Mark VI

The Mark VI was an evolution of the Mk V, featuring only detail improvements. The driver sat at the front on the left, with the commander and gunner/radio operator in the turret. The old No.1 radio was replaced by an improved (but still flawed) No.7 radio in the turret rear. The major change came late in the production run with the decision to replace the Vickers MGs with Besa models. Thus the Mk VI-VIB used a .303 and the underpowered and unreliable 0.5-inch Vickers, while the last batch of Mk VIB were completed as Mk VIC with a 7.92mm and a 15mm Besa, the latter more powerful than the Vickers but even less reliable and inaccurate in burst fire due to whipsaw of the long, thin barrel. The Mk VIB was the most numerous tank of the BEF and, although useful only in the scouting role, by default served as a battle tank, with attendant losses.

A basic Mk VI light tank



	Weight (tonnes)	4.68	Front Armor (mm)	14
	Length (m)	3.92	Side Armor (mm)	9
	Width (m)	2.01	Engine HP	88
	Height (m)	2.20	Road Speed (km/h)	58



Light Tank, Mark VII (Tetrarch)

The Tetrarch marked a radical departure from the preceding line of light tanks. It had four large road wheels, the rear serving also as the drive sprocket, and utilized warp steering in which the roadwheels could be turned at small angles to shift the track for high-speed turns. For harder turns conventional brake steering was employed. The vehicle was armed with a 2pdr gun (with 50 rounds) and coaxial Besa 7.92mm MG in the turret. A small number were built as CS versions in which a 3" howitzer replaced the 2pdr. By the time they came into general service in late 1941 their usefulness was already limited by their two-man turret and weak armament. Most were put in storage to await availability of the Hamilcar glider, designed specifically for this tank. A few were thus used by the 6th Airborne Division in the Normandy invasion.

Mark VII Tetrarch light tank



	Weight (tonnes)	6.8	Front Armor (mm)	16
	Length (m)	4.05	Side Armor (mm)	n/a
	Width (m)	2.31	Road Speed (km/h)	25
	Height (m)	2.11		

Light Tank, Mark VIII (Harry Hopkins)

This was a further development of the Tetrarch with a redesigned turret and hull for better shot deflection and thicker armor. The unique steering system was retained but power assist added to reduce driver fatigue. The armament remained the same, a 2pdr gun (with 50 rounds) and a 7.9mm Besa, and tapered-bore Littlejohn adaptors were sometimes fitted to the main gun to improve AP penetration, as with the Tetrarch. Although an improvement over the Tetrarch the increased weight made it unsuitable for glider operations and by the time it came into service the light tank concept had fallen out of favor with the British Army. As a result, the Hopkins never saw combat. It did serve as the basis for the Alecto SP 95mm howitzer, but that never saw combat either, being too late.



	Weight (tonnes)	7.7	Front Armor (mm)	38mm
	Length (m)	4.34	Side Armor (mm)	n/a
	Width (m)	2.74	Engine HP	148
	Height (m)	2.11	Road Speed (km/h)	50

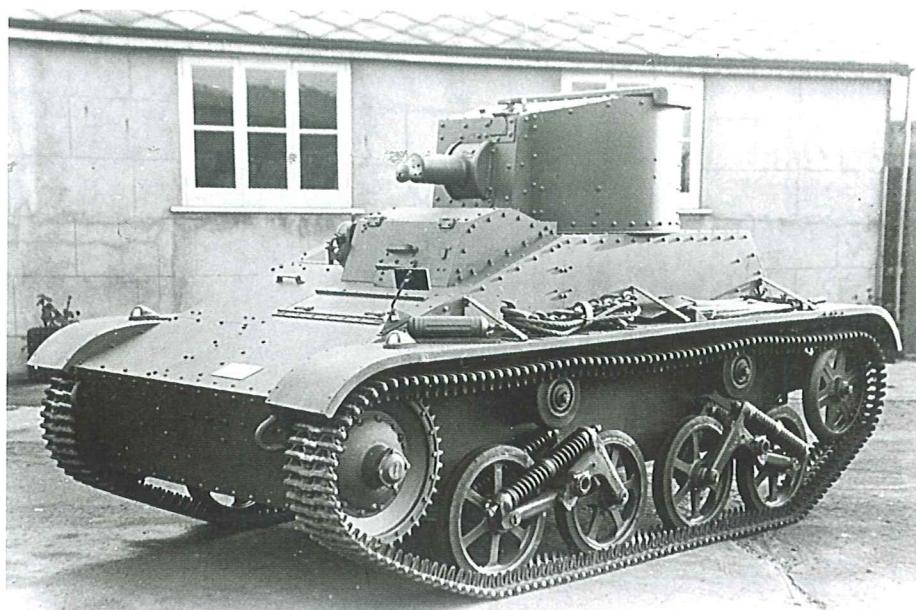
Mk VIII Hopkins light tank



Vickers Commercial Light Tanks

In addition to developing and building light tanks for the British Army, Vickers Armstrong built similar vehicles for export during the 1930s. Details varied slightly and they were often referred to by the year of manufacture, i.e., Model 1935, but this does not appear to have been an official V-A designation system. They were typically two-man vehicles with a small turret mounting a single rifle-caliber machine gun. Weight usually varied from 3.3 to 3.8 tons and maximum armor thickness from 7mm to 11mm. Radios were optional, but appear to have been fitted only infrequently. Amphibious versions, with wide hulls to ensure flotation in still water, were also developed and sold. Their thin armor, 2-man crew and lack of a radio rendered them obsolete by 1939, although they continued to soldier on in a few countries where replacements were unavailable, such as China, Thailand and Argentina.

Vickers Armstrong light tank model 1935

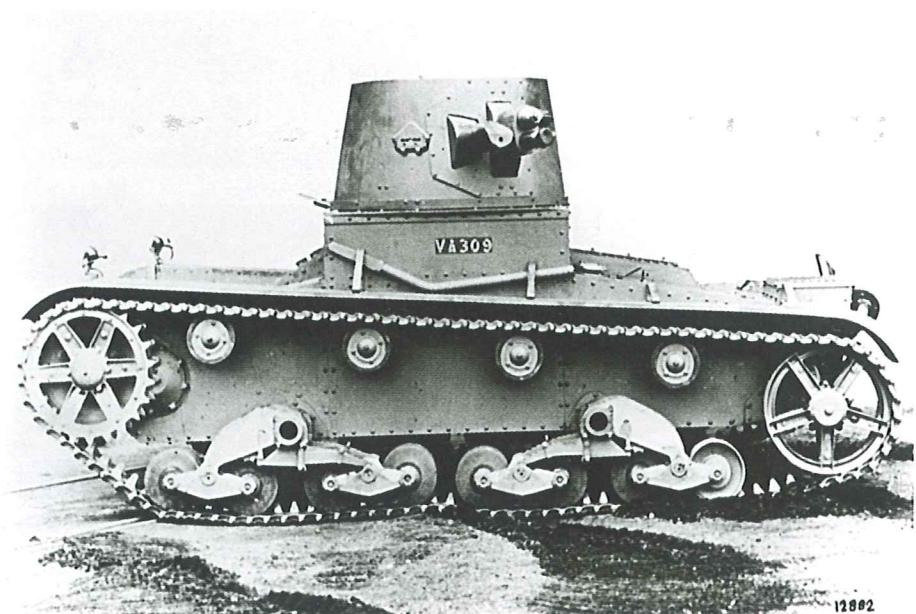


	Weight (tonnes)	3.02	Front Armor (mm)	9
	Length (m)	3.54	Side Armor (mm)	7
	Width (m)	1.91	Engine HP	88
	Height (m)	1.98	Road Speed (km/hr)	60

Vickers Medium E Tank (6-ton)

A commercial venture designed in the late 1920s, the Medium E was never adopted by the British Army, but was widely sold for export. There were two basic versions of the Medium E, a twin-turret model and a single-turret model. The former was usually armed with a single rifle-caliber machine gun in each turret, each of which covered a 100° field of fire. The latter usually featured a short-barrel 3pdr (47mm) Vickers gun and a coaxial MG. Radios were optional in both models. The crew was two or three depending on the model. Power was from a horizontal, air-cooled, 4-cylinder Armstrong Siddeley engine. The single-turret model was a well-balanced tank for its time, the early 1930s, but had clearly slipped into obsolescence by 1939.

A single turret medium E before being shipped to Greece for trials, 1931



	Weight (tonnes)	7.02	Front Armor (mm)	17
	Length (m)	4.54	Side Armor (mm)	n/a
	Width (m)	2.17	Engine HP	80
	Height (m)	2.40	Road Speed (km/hr)	37



Cruiser, Mark I (A9)

The first of the new series of cruiser tanks featured an archaic armament configuration of a main gun and a coaxial Vickers .303 water-cooled machine gun in the main turret, plus two more MGs in the two auxiliary turrets at the front. The 2pdr main gun was powerful, however, and the three-man turret was efficient and in advance of its time. It was also the first British tank to feature power traverse for the turret. After modifications to the prototype the tank proved reliable, although the tracks continued to show weaknesses. On the other hand, its armor was pitifully thin for a battle tank, providing protection only against small arms fire and fragments. About a quarter of 125 tanks built were close-support (CS) versions that substituted a 3.7" howitzer for the 2pdr gun.



Cruiser Mk I CS with the 3.7" howitzer (TMB)

	Weight (tonnes)	10.8	Front Armor (mm)	14
	Length (m)	5.83	Side Armor (mm)	n/a
	Width (m)	2.52	Engine HP	150
	Height (m)	2.52	Road Speed (km/hr)	42

Cruiser, Mark II (A10)

The A10 was essentially an uparmored version of the A9. To achieve this they eliminated the near-useless auxiliary turrets at the front and carried the vertical plate in front of the driver straight across. Extra armor was then bolted to the hull and turret fronts to effectively double its thickness. The added weight, however, reduced the speed considerably. The original model was to have carried a 2pdr and a Vickers MG in the turret and a Besa MG in the hull front, although the hull mounting was usually empty to simplify ammunition supply. The Mark IIA changed the Vickers weapon for a Besa and added the Besa in the hull front. About a quarter of the II/IIA cruisers were CS models with a 3.7" howitzer in place of the 2pdr. As with the Cruiser Mk I, some Mk IIs were sent to France with the BEF, but most served in North Africa until retired in 1941.



	Weight (tonnes)	12.38	Front Armor (mm)	30
	Length (m)	5.47	Side Armor (mm)	n/a
	Width (m)	2.51	Engine HP	150
	Height (m)	2.54	Road Speed (km/hr)	27

Cruiser Mk II in the desert (TMB)



Cruiser Marks III & IV (A13)

The Mk III cruiser was armed with a 2pdr gun and coaxial Vickers in the turret, having no bow gun. It was armored to the same standard (maximum 14mm) as the Mk I cruiser and was quickly superseded on the production line by the Mk IV, in which armor plates were added to the hull front and turret to bring protection into line with the Mk II. In the case of the turret these were angled out from the top and bottom, giving the originally box-shaped turret a completely different look. Some Mk IIIs were retrofitted with turret armor to approximate the Mk IV. The Mk IVA replaced the Vickers MG with a Besa weapon. The combination of the Christie suspension and Liberty engine produced a fast tank, a characteristic valued in the desert, although the engine proved prone to breakdown. There were no CS versions of either model.

Cruiser Mk IV with the supplemental armour over gun mount (TMB)



	Weight (tonnes)	13.28	Front Armor (mm)	30
	Length (m)	5.98	Side Armor (mm)	n/a
	Width (m)	2.50	Engine HP	340
	Height (m)	2.57	Road Speed (km/hr)	50

Cruiser Mark V (A13 Mk 3) Covenanter

This was an evolution of the Mk IV, but with the increased armor thickness built in from the start in a highly-sloped configuration and a new horizontally-opposed engine. Armament consisted of a 2pdr gun (3" howitzer in the CS version) and a Besa MG in the turret. The armament was adequate for its time (if just barely), and the tank was sleek and fast, with well-sloped armor. Unfortunately, the concept of placing the engine in the rear and radiator at the front proved disastrous, and repeated attempted fixes through several marks of Covenanter all failed to cure overheating problems, leaving the tank suitable only for training use. As a result, only a handful ever left the UK and it never saw combat.



	Weight (tonnes)	16.2	Front Armor (mm)	40
	Length (m)	5.76	Side Armor (mm)	n/a
	Width (m)	2.59	Engine HP	300
	Height (m)	2.22	Road Speed (km/hr)	52

Cruiser MK V Covenanter (TMB)



Cruiser Mark VI (A15) Crusader

Developed in parallel with, but slightly later than, the Covenanter, the Crusader abandoned the engine and cooling system of that tank in favor of a more conventional design that slightly improved reliability. It was also slightly longer with an additional roadwheel per side, which improved ground loading. The Crusader I mounted a 2pdr and a coaxial Besa in the turret and a second Besa in a small front hull turret next to the driver. The Crusader II dispensed with the small machine gun turret and crewman (which was also retrospectively removed from some Mk Is) and increased the armor slightly from a maximum of 40mm to 49mm. The Crusader III modified the turret to accept a 6pdr gun with Besa, but at the cost of one crewman. The Crusader was widely used in the desert campaigns, where it proved fast but unreliable. They were removed from service after the fall of Tunisia.

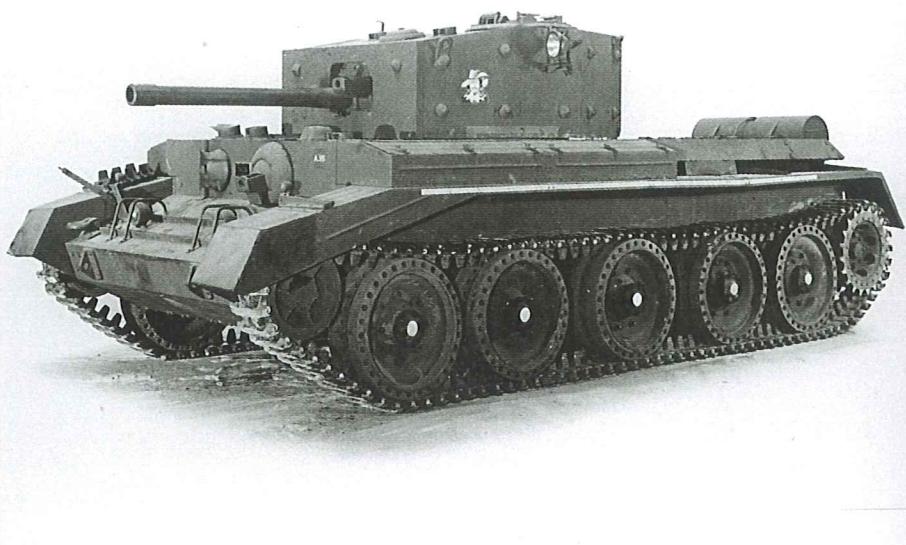
Crusader I (TMB)



	Weight (tonnes)	17.1	Front Armor (mm)	49
Length (m)	5.96	Side Armor (mm)	n/a	
Width (m)	2.61	Engine HP	340	
Height (m)	2.22	Road Speed (km/hr)	45	

Cruiser Mark VII (A24) Cavalier

This vehicle took the Crusader mechanicals and mated them with a new hull with thicker armor and a new turret that accommodated both the 6pdr gun (with coaxial Besa) and the 3-man crew. This led to a more efficient fighting configuration, but the vehicle was actually somewhat less reliable than the Crusader due to the extra weight. Most vehicles were fitted with a second Besa in the forward hull, but some lacked this feature. Few were built and none saw combat as gun tanks, although about half were converted to artillery observation vehicles and used in that role in NW Europe with the artillery regiments of the armored divisions. Others had their turrets removed and recovery equipment installed.



	Weight (tonnes)	23.85	Front Armor (mm)	76
Length (m)	6.31	Side Armor (mm)	n/a	
Width (m)	2.88	Engine HP	410	
Height (m)	2.42	Road Speed (km/hr)	40	

Cavalier cruiser tank (TMB)



Cruiser Centaur

The Centaur was almost identical to the Cavalier, but featured changes to the internal arrangements, particularly in the engine compartment. These were designed to permit a switch from the old Liberty engine to the new Rolls Royce Meteor when that unit became available. The longer production run of the Centaur meant that several versions were built, notably the Mk I and II with 6pdr gun and coaxial 7.92mm Besa, the Mk III with 75mm gun and Besa, and the Mk IV, a close-support version with 95mm howitzer and Besa. The Mk III was the first British cruiser with a 75mm gun. The only vehicles used as gun tanks in combat were 80 Mark IVs issued to the Royal Marines for use in Normandy. Others were converted to specialized roles such as turretlss dozer, OP, recovery vehicle, AA, and so on.

Royal Marines prepare their Centaur Ivs with waterproofing kits (TMB)



	Weight (tonnes)	24.75	Front Armor (mm)	76
	Length (m)	6.31	Side Armor (mm)	n/a
	Width (m)	2.89	Engine HP	395
	Height (m)	2.47	Road Speed (km/hr)	45

Cruiser Cromwell

The Cromwell used the same hull and turret as the earlier Cavalier and Centaur, but replaced the old Liberty engine with the new Rolls Royce Meteor. This new power plant raised the top speed to an impressive 67 km/hr, although it was geared down to 53 km/hr from the Mk IV on to prevent damage to the running gear. The Mk I was armed with the 6pdr, a coaxial 7.92mm Besa and a second Besa in the hull front. The Mk II eliminated the hull MG and used wider tracks. The Mk IV and V replaced the 6pdr with a 75mm, while the Mk VI used a 95mm howitzer. Mk VII and VIII added 25mm appliqué armor to the Mk IV-VI. Although better than its predecessors, the Cromwell was still not as reliable as it should have been. The main shortcoming was that the 75mm gun, like its American cousin, was underpowered by the time it entered combat.

Cromwell IV



	Weight (tonnes)	24.75	Front Armor (mm)	76
	Length (m)	6.31	Side Armor (mm)	n/a
	Width (m)	2.89	Engine HP	600
	Height (m)	2.47	Road Speed (km/hr)	67



Cruiser Challenger

The Challenger was a largely unsuccessful attempt to mount the powerful 17pdr gun on a modified Cromwell hull. The center section of the hull top was widened to accommodate a tall, wide turret with space for four men (including two loaders), the 17pdr and a coaxial Browning .30cal MG. The bow MG position was eliminated as a result. The chassis was lengthened and an extra roadwheel added to each side to carry the weight, but the turret front armor thickness still had to be reduced from 75mm on the Cromwell to 63mm and the side armor from 65mm to 40mm, although 25mm appliqué was fitted to some vehicles in compensation. The lengthened hull made driving difficult and it was no more reliable than Cromwell. When it proved possible to mount the 17pdr in a Sherman, production of the Challenger was curtailed.

Challenger (TMB)



	Weight (tonnes)	28.35	Front Armor (mm)	102
	Length (m)	7.98	Side Armor (mm)	n/a
	Width (m)	2.87	Engine HP	600
	Height (m)	2.64	Road Speed (km/hr)	53

Cruiser Comet

The final development of the cruiser, the Comet, was an excellent tank. Reliability had improved, and the tank was fast and agile, powerfully armed and adequately protected. The main armament was the 77mm gun, essentially a cut-down 17pdr that lost little of that weapon's effectiveness. A 7.92mm Besa was mounted coaxially, and a second one fitted in the hull front. The hull and turret were all welded, a feature used on the later versions of Cromwell. It retained the Christie-type suspension of the earlier cruisers, but added track-return rollers for the first time. The engine and transmission were the same as the Cromwell, as were many other components. It only saw combat in the last two months of the war in Europe, but remained in service with the British Army for years afterward.

Comet cruiser tank (TMB)



	Weight (tonnes)	29.25	Front Armor (mm)	101
	Length (m)	7.86	Side Armor (mm)	n/a
	Width (m)	3.03	Engine HP	600
	Height (m)	2.60	Road Speed (km/hr)	48



Infantry Tank, Mk I (A11) Matilda I

The original infantry tank, the Matilda I was a small vehicle powered by a civilian model Ford V-8 engine. It was extremely slow and had an 80 mile road range, rendering mobile operations out of the question, and the two-man crew meant that the commander/gunner/loader was severely overloaded. The normal armament was a single .303 water-cooled Vickers MG, although the .5-inch version could be substituted. Obstacle-crossing capability was rated as good and its small size made it rather inconspicuous. Nevertheless, its sole saving grace was that the frontal armor was impervious to any German tank or anti-tank gun. Of course, armed with only a machine gun it could not harm any German tank it came across either. In light of its shortcomings only 139 were built, of which 97 were lost with the BEF in 1940. That was to be their last combat.

The Mk I Infantry tank (TMB)

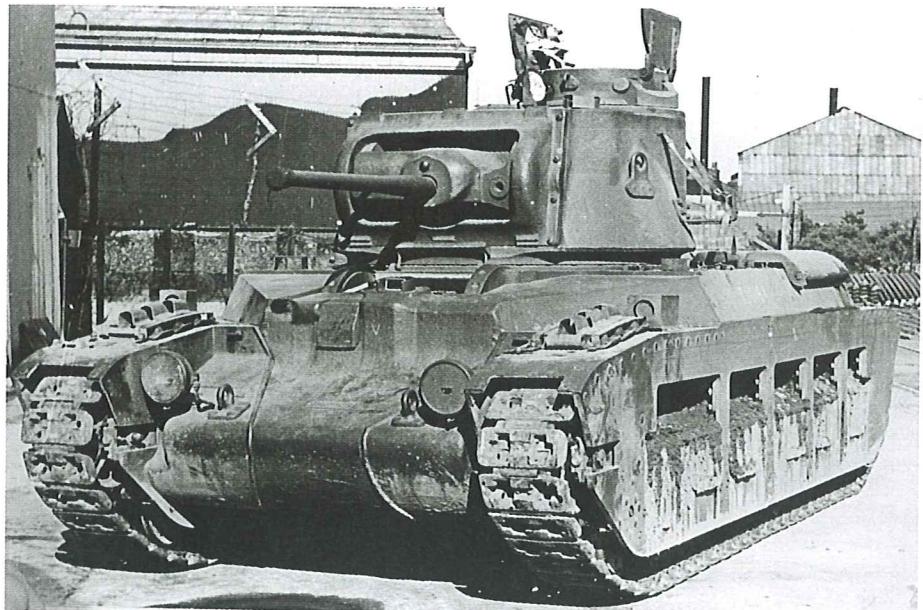


	Weight (tonnes)	9.9	Front Armor (mm)	60
Length (m)	4.51	Side Armor (mm)	n/a	
Width (m)	1.96	Engine HP	70	
Height (m)	1.81	Road Speed (km/hr)	13	

Infantry Tank, Mark II (A12) Matilda

Confusingly, once the Mk I infantry tank was retired, this vehicle simply became known as the Matilda, and when modifications were introduced a numbering system was promulgated, so that the designation Matilda I was reused to mean the original version of the Mark II. This was a larger and more capable tank than its predecessor. At over twice the weight it not only featured thicker armor, but a wider hull that allowed the use of a larger 3-man turret. The new turret incorporated a 2pdr gun and a coaxial MG (Vickers in Matilda I, Besa in the later versions). Early models used twin AEC diesels, later ones Leyland gasoline engines. The hull castings made for a sturdy vehicle, but slowed production considerably. The tank was reliable and proved popular, although the small turret left no room for a larger gun and thus consigned it to obsolescence by late 1942.

Infantry tank Mk II Matilda (TMB)



	Weight (tonnes)	23.85	Front Armor (mm)	78
Length (m)	5.60	Side Armor (mm)	n/a	
Width (m)	2.57	Engine HP	174	
Height (m)	2.42	Road Speed (km/hr)	25	



Infantry Tank, Mark III Valentine

The Valentine utilized the chassis, suspension, engine and transmission of the A10 Cruiser. The Valentines I to V were armed with a 2pdr and a coaxial Besa MG. The VIII and IX were upgunned to a 6pdr but lost the MG to make room. The Valentine X had the 6pdr with the coaxial MG, while the XI carried a 75mm gun with MG. Models VI and VII were Canadian-built versions of the Valentine IV. Only the Valentines III and V had three-man turrets. They represented a compromise of characteristics, too slow to be a cruiser and too lightly armored for a true infantry tank, while the 2-man turret was inefficient, as was the lack of any machine gun armament in some models. Nevertheless, they were reliable machines and generally popular, and were used as the basis for several specialized variants, including bridgelayers and mineclearers.

Right: Valentine 2pdr (TMB)

Below: A Valentine Mk X with 6pdr gun



	Weight (tonnes)	14.4	Front Armor (mm)	65
	Length (m)	5.38	Side Armor (mm)	n/a
	Width (m)	2.60	Engine HP	131
	Height (m)	2.24	Road Speed (km/hr)	25





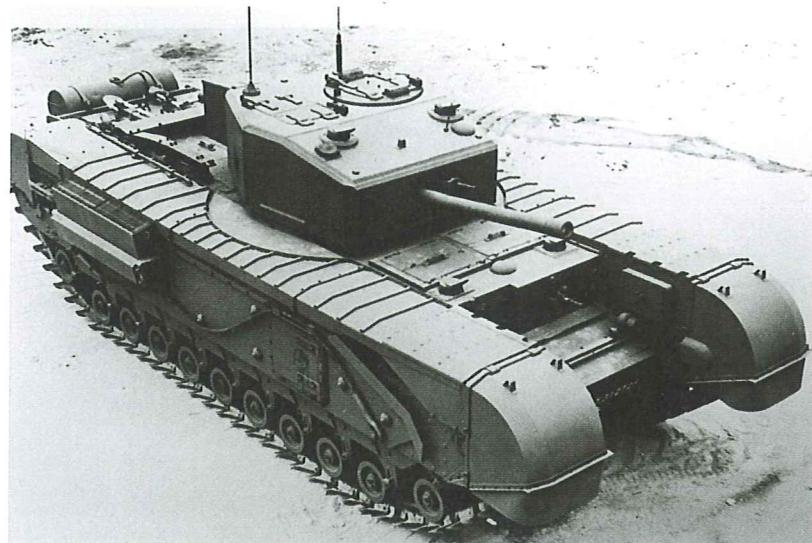
Infantry Tank, Mark IV (A22) Churchill

Early production models were highly unreliable due to rushed introduction, but these problems were quickly (if painfully) sorted out. The Churchill up to Mk VII used a double-hull construction, with an inner layer 12mm thick of mild steel, to which were bolted the main armor plates. The configuration of running the tracks along the upper part of the hull, together with the small spring bogey system, left a lot of room in the hull sides for ammunition and other stowage, making the tank interior roomy. The low speed rendered irrelevant the disadvantages of the suspension.

The Churchill I mounted a 2pdr and a coaxial Besa in the turret and a 3" howitzer in the hull. The Churchill II replaced the howitzer with a second Besa. The Mks III and IV replaced the 2pdr with a 6pdr gun, the Mk IV also seeing the shift from welded to cast turret. The Mk V used a 95mm howitzer as a close-support tank. The Mk VI was a Mk IV with a 75mm gun in lieu of the 6pdr. The Mk VII marked the introduction of the "heavy Churchill" with maximum armor thickness raised from 102mm to 152mm. The Mk VII used the 75mm gun, while the Mk VIII had the 95mm howitzer.

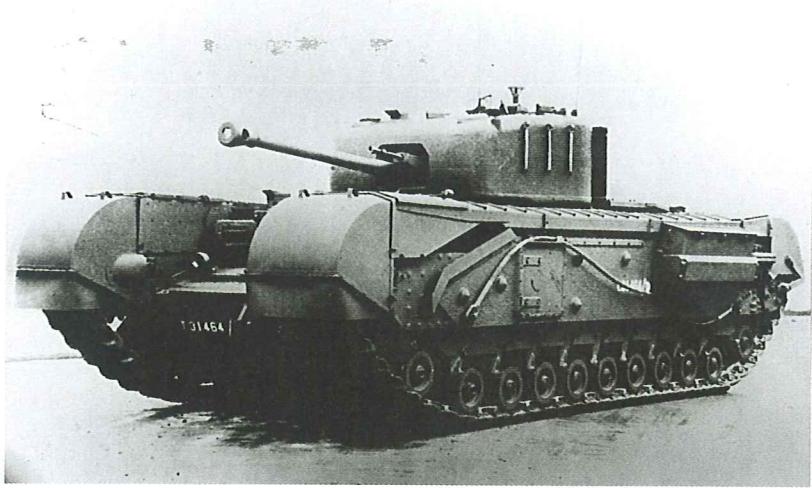
The success and popularity of the Churchill ensured a continuing upgrade program. Churchill I and II models were upgraded to Mk III standards with new turret and gun. British forces in Italy refitted 120 of their Mk IVs with 75mm guns and mounts from wrecked Shermans to create the Churchill IV (75NA), while a large number of 6pdr models were converted to 75mm models at home as the Churchill X, some with and some without the new heavy turret.

The spacious hull also made the Churchill popular for conversion into specialized vehicles, particularly the AVRE with its demolition petard mortar.



First column Churchill II,
Second column Churchill IV

	Weight (tonnes)	34.65	35.10
	Length (m)	7.42	7.42
	Width (m)	3.23	3.23
	Height (m)	2.47	2.73
	Front Armor (mm)	102	102
	Side Armor (mm)	n/a	n/a
	Engine HP	350	350
	Road Speed (km/hr)	26	26



Top: Churchill I infantry tank

Middle: Churchill III/IV infantry tank

Bottom: Churchill VI infantry tank



Tank Destroyer, Archer

This vehicle married the potent 17pdr anti-tank gun with the chassis of the proven Valentine tank. The gun was mounted facing rearward over the engine deck in a low open-topped fighting compartment. No under-armor machine gun was provided, although a Bren gun was carried for dismounted use and some vehicles later received an AA mount for the Bren or a Browning .30cal weapon. The vehicle carried 39 rounds for the main gun. The vehicle's slow speed, limited traverse of the gun (11° each side of center) orientated to the rear, and the fact that the driver's position had to be vacant in order to fire the gun constrained its tactical usefulness. Nevertheless, the powerful armament and low silhouette made it a dangerous adversary and it remained in service with the British Army into the 1950s.

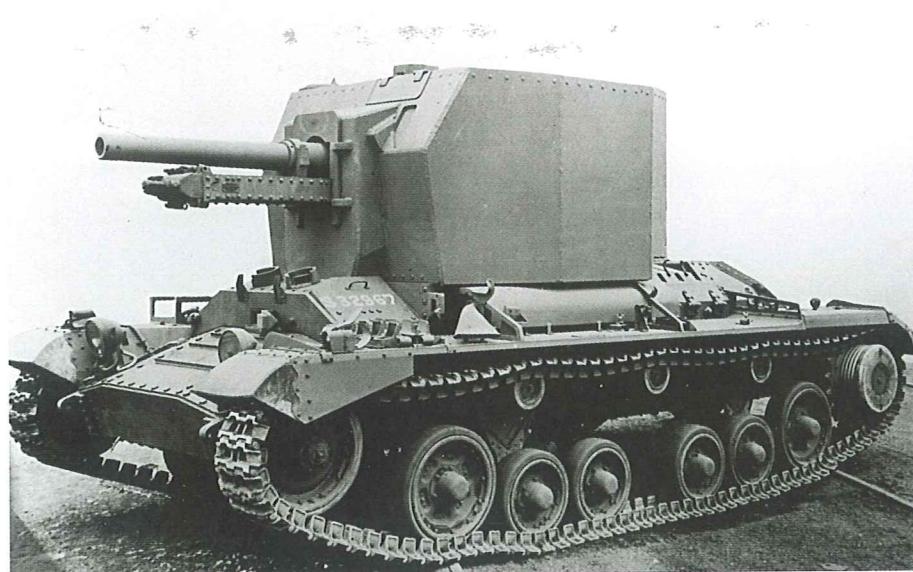


Archer SP 17 pdr seen from the front

	Weight (tonnes)	14.4	Front Armor (mm)	60
Length (m)	6.64	Side Armor (mm)	n/a	
Width (m)	2.73	Engine HP	192	
Height (m)	2.22	Road Speed (km/hr)	33	

Self-Propelled Gun, Bishop

The Bishop was a hurried attempt to create a self-propelled weapon by marrying the proven 25pdr gun-howitzer with the chassis of the Valentine. The tank was a bit narrow to mount the gun in the hull, so an open-topped box-shaped superstructure was built above. The vehicle carried a Bren gun on an open AA mount and 32 rounds of 25pdr ammunition. The extemporized nature of the vehicle showed itself in a number of shortcomings, including the high silhouette, limited traverse of only 4 degrees each side, and the maximum elevation of only 15 degrees, which restricted the range of the gun. The choice of the Valentine made sense in that it was one of the more reliable tanks available, but it also gave the vehicle a top speed of only 25 km/hr. They served in North Africa from the Alamein battle, but were retired to training duties shortly thereafter.



	Weight (tonnes)	15.48	Front Armor (mm)	60
Length (m)	5.50	Side Armor (mm)	n/a	
Width (m)	2.59	Engine HP	131	
Height (m)	2.75	Road Speed (km/hr)	25	

Bishop SP 25 pdr



Armored Car, Rolls-Royce

The original 1920 Pattern models were almost identical to those built on the Silver Ghost 4x2 chassis during World War I. The 1924 Pattern and the 1920 Pattern Mark IA had a slightly redesigned hull and turret and featured a cupola for the commander. All were armed with a single Vickers .303 MG in the turret. On the outbreak of war the 11th Hussars in Egypt replaced the turret with an open-topped version with a Bren light MG and a Boys AT rifle. The RAF lifted the hulls off the old chassis and placed them on Fordson 4x2 chassis and modified the turret to accept a Boys AT rifle next to the Vickers gun and pintle-mounted a Lewis MG on top. Once modified for local conditions, the Rolls Royces proved popular in North Africa and the Middle East, being reliable and rugged. They were clearly obsolete by 1941, however, and were removed from front-line combat shortly thereafter.

An RAF Fordson/Rolls Royce 1924 Pattern outside Baghdad 1941 (TMB)

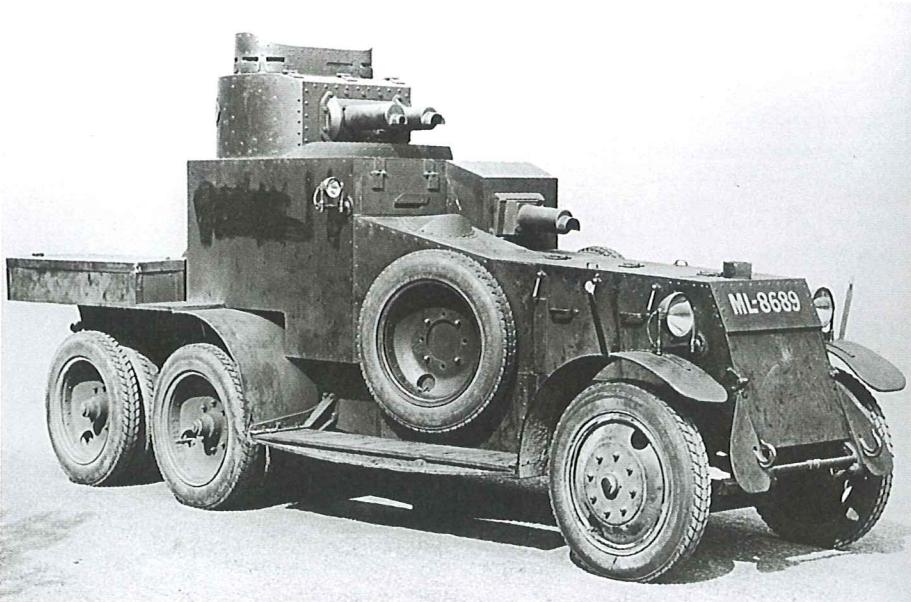


	Weight (tonnes)	3.7	Front Armor (mm)	9
	Length (m)	4.92	Side Armor (mm)	9
	Width (m)	1.93	Engine HP	50
	Height (m)	2.54	Road Speed (km/h)	75

Armored Car, Lanchester

Generally typical of the British armored cars of the late 1920s and early 1930s was the big Lanchester. The layout was similar to that of the Rolls-Royces, with the engine at the front, crew and turret space in the center and a flat bed at the rear. There were four marks of the vehicle, all similar except that the Marks I and IA had twin rear wheels, while the IA and IIA had radios, which replaced the hull machine gun. Armament consisted of a .5-inch and a .303-inch Vickers MG coaxial in the turret and, in vehicles without a radio, a second .303 Vickers next to the driver. A total of 18 Mk I, 4 Mk IA, 7 Mk II and 6 Mk IIA were built. Despite their 6x4 drive they were found too heavy and of limited cross-country performance and were retired from regular service before the start of the war. They were handed over to forces in Malaya in 1941 where they were destroyed by the invading Japanese.

Lanchester Mk I (TMB)



	Weight (tonnes)	6.26	Front Armor (mm)	9
	Length (m)	6.10	Side Armor (mm)	9
	Width (m)	2.01	Engine HP	88
	Height (m)	2.82	Road Speed (km/h)	75



Armored Car, Humber

The Humber Mk I was simply the body of the Guy IA armored car dropped on to the 4x4 KT4 chassis, dramatically improving reliability. The new engine also improved the power-to-weight ratio. Armament thus remained the same, one 15mm and one 7.92mm machine gun in the turret. A redesigned hull yielded the Mk II, which also introduced a remotely-raised engine deck grille to clear the driver's line of sight when driving in reverse. The Mk III changed to a new turret providing cramped space for three men. The Mk IV was the major change, with the unpopular 15mm Besa being replaced by an American 37mm tank gun. Although overshadowed late in the war by the more technologically advanced Daimler, the Humber remained popular and in service to the end of the conflict.

Humber Mk II armored car



	Weight (tonnes)	6.39	Front Armor (mm)	15
	Length (m)	4.55	Side Armor (mm)	n/a
	Width (m)	2.15	Engine HP	90
	Height (m)	2.20	Road Speed (km/hr)	75

Armored Car, Daimler

The Daimler differed dramatically from earlier British armored cars in having no frame. Instead, the automotive components were bolted directly to the lower body. The four wheels were independently sprung without axles and were driven by four shafts from the preselector transmission. The turret was similar to that used on the Tetrarch light tank and featured a 2pdr gun with a 7.92mm Besa MG coaxial. In common with most armored cars, the turret only accommodated two men, not a major defect in vehicles not designed to fight as line elements. A rear-facing steering wheel was provided for fast reversing. The Mk II differed in only small details, mostly interior components. Once the crews got used to them the Daimlers proved the most popular of the British armored cars, tough, reliable and agile.

Daimler Mk I armored car



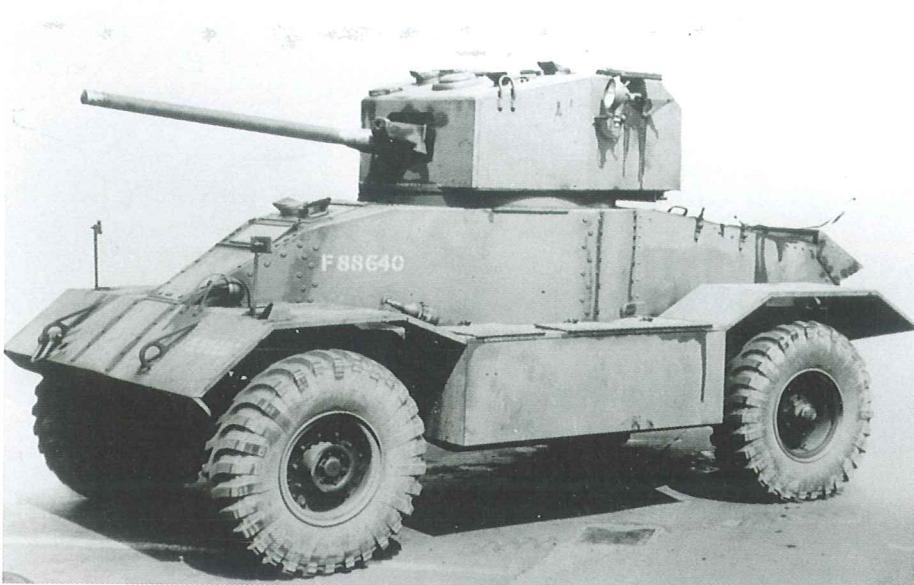
	Weight (tonnes)	6.75	Front Armor (mm)	16
	Length (m)	3.94	Side Armor (mm)	n/a
	Width (m)	2.43	Engine HP	95
	Height (m)	2.22	Road Speed (km/hr)	83



Armored Car, AEC

Based on the chassis of the AEC Matador 4x4 artillery tractor, this derivative was the heaviest of the British armored cars. The long, narrow hull was more heavily armored than other British armored cars. Normal drive was to the front wheels, with the rear wheels being engaged in rough terrain. The Mk I used turrets taken from early Valentine tanks being converted to bridgelayers, armed with a 2pdr gun and a coaxial 7.92mm Besa. The Mk II featured a slightly redesigned hull and a new turret with a 6pdr gun and Besa, while the Mk III replaced the 6pdr with a 75mm. The powerful engine and thick armor made it popular for specialized roles, especially in the heavy troops of armored car regiments where they provided fire support for Daimlers and Humbers. It was a bit tall and the ground-loading a little high for general purpose usage, however.

AEC Mk II armoured car



	Weight (tonnes)	11.43	Front Armor (mm)	30
	Length (m)	5.40	Side Armor (mm)	n/a
	Width (m)	2.68	Engine HP	158
	Height (m)	2.67	Road Speed (km/hr)	68

Armored Car, Coventry

This was the culmination of British armored car design during the war, representing a collaboration between Humber and Daimler. The turret and overall hull shape approximated those of the Daimler, but the designers retreated from the independent suspension to use axles and two drive shafts. As in the Daimler, duplicate driving controls were provided at the rear for facilitate rapid disengagement from the enemy. Armament consisted of a 2pdr and a coaxial 7.92mm Besa in a 3-man turret in the Mk 1 version. A Mk 2 version mounted a 75mm gun (losing one turret crewman to make room) but was not produced during the war. An effective design, the Daimler armored car was so popular that it remained in production, only the Humber factory turning out the Coventry.

Coventry Mk I armoured car



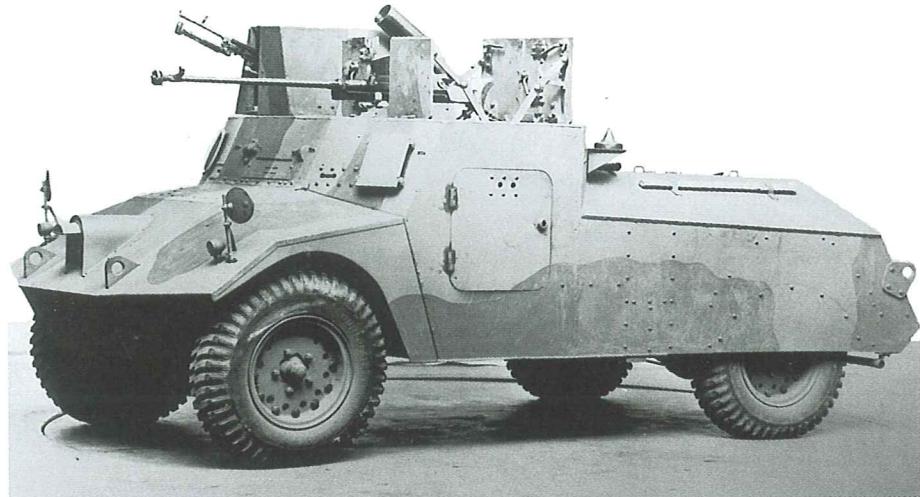
	Weight (tonnes)	10.35	Front Armor (mm)	14
	Length (m)	4.71	Side Armor (mm)	n/a
	Width (m)	2.64	Engine HP	175
	Height (m)	2.35	Road Speed (km/hr)	68



Light Reconnaissance Car, Morris

The Morris, and related Humber, light reconnaissance cars were hurriedly developed in 1940 to provide a quick solution to the shortage of armored vehicles following the loss of BEF equipment. The Morris had a 3-man crew, all at the front, consisting of a driver in the center and, slightly behind him, a gunner with a small open-topped turret with a Bren gun on his right and a radio operator to his left. The radio operator had a hatch that opened forward with a slit into which a Boys AT rifle could be mounted. The Mk I version had only 4x2 drive, but the Mk II was 4x4. The Humber reconnaissance car was 4x2 in the Mk I and Mk II versions and 4x4 in the Mk III. The first two were unarmed, but the Mk III had a turret with a Bren gun at the rear, and a slit in the forward face for an AT rifle.

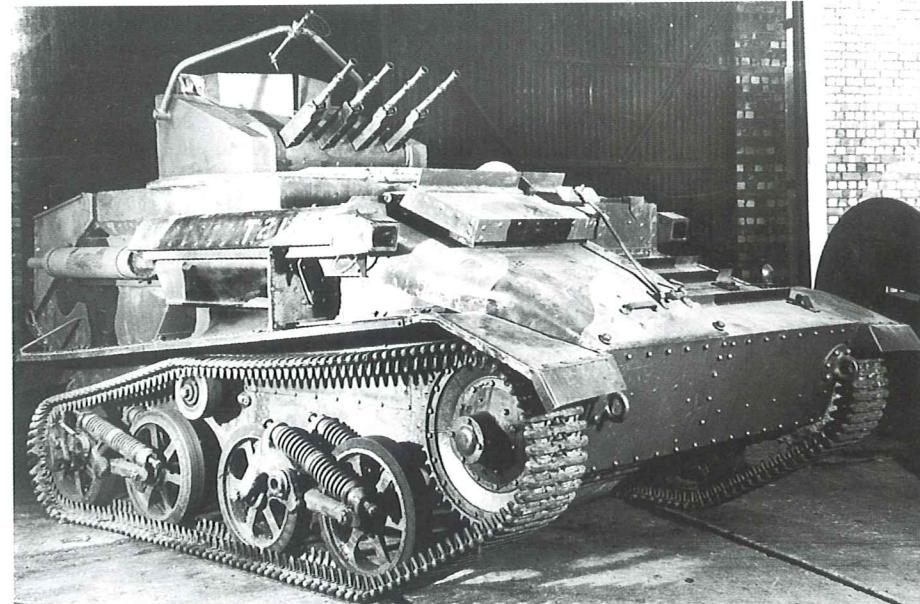
Morris light reconnaissance car



	Weight (tonnes)	3.33	Front Armor (mm)	14
	Length (m)	4.01	Side Armor (mm)	n/a
	Width (m)	2.02	Engine HP	72
	Height (m)	1.87	Road Speed (km/hr)	83

Light Anti-Aircraft Tanks

There were two anti-aircraft versions of the light tank. The Light AA Tank Mk I used the chassis of the Mk VIA light tank fitted with a power-operated open-top turret with four 7.92mm Besa MGs set side-by-side. The Light AA Tank Mk II used the chassis of the Mk VIB light tank and featured a number of improvements, including a better sighting system that projected above and forward of the turret, a roomier, more accessible turret and ammunition stowage bins at the rear. They were better than nothing (albeit just barely) and served in tank battalion and regiment HQs in North Africa, but their armament was weak and by 1943 the light tanks on which they were based were no longer in use. They were removed from service in that year.



	Weight (tonnes)	4.7	Front Armor (mm)	14mm
	Length (m)	3.93	Side Armor (mm)	n/a
	Width (m)	2.06	Engine HP	88
	Height (m)	2.20	Road Speed (km/h)	58

A Mk II light AA tank



Anti-Aircraft Tank, Crusader AA II

The original Crusader AA tank was a simple conversion, replacing the turret of the Crusader III with a Bofors 40mm on a field mounting with thin armor shielding. The more advanced AA II model utilized a specially-designed turret with twin 20mm Oerlikon guns. The turret had a crew of two, a commander/gunner and a loader, while the driver sat in the hull front. The Crusader AA III was almost identical to the AA II model but the radio was moved from the turret to the hull front next to the driver to free turret space. The design appears to have been well thought-out, although the questionable mechanical reliability of the Crusader might have been a minor problem. By the time they entered service, however, the air threat had all but disappeared and they saw little operational use, for the most part being retained in storage in Britain.

Crusader AA II anti-aircraft tank

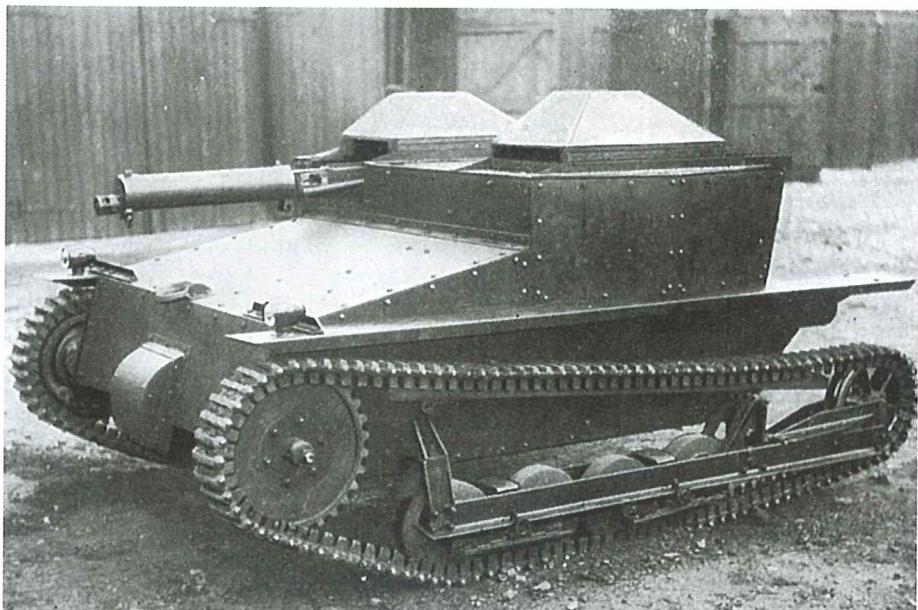


	Weight (tonnes)	c19.8	Front Armor (mm)	51
Length (m)	5.96	Side Armor (mm)	n/a	
Width (m)	2.61	Engine HP	340	
Height (m)	c2.25	Road Speed (km/h)	45	

Carden-Loyd Machine Gun Carrier Mk VI

Although out of front-line service with the British Army by the outbreak of the war, these little vehicles were the mainstay of the armored force of many smaller states. They were mainly significant, however, for their questionable contribution to tank development, with Czechoslovakia, Italy, Poland and the Soviet Union all license-producing derivative vehicles. The Mk VI was a tiny vehicle with a crew of two that sat side-by-side with the engine behind and between them. The driver sat on the left and gunner on the right, the latter with a single rifle-caliber machine gun, usually a Vickers water-cooled model. Hinged armored head covers in the form of truncated pyramids were a popular, but not universal, option. A later version with slightly higher armor superstructure was known as the Mk VI* or Mk VIA. Their armor was proof against rifle-caliber ball ammunition but little else. In service they proved to have little ground clearance and a rather fragile track system that contributed to breakdowns in rough terrain.

A Mk VI with armored head-covers in the lowered position

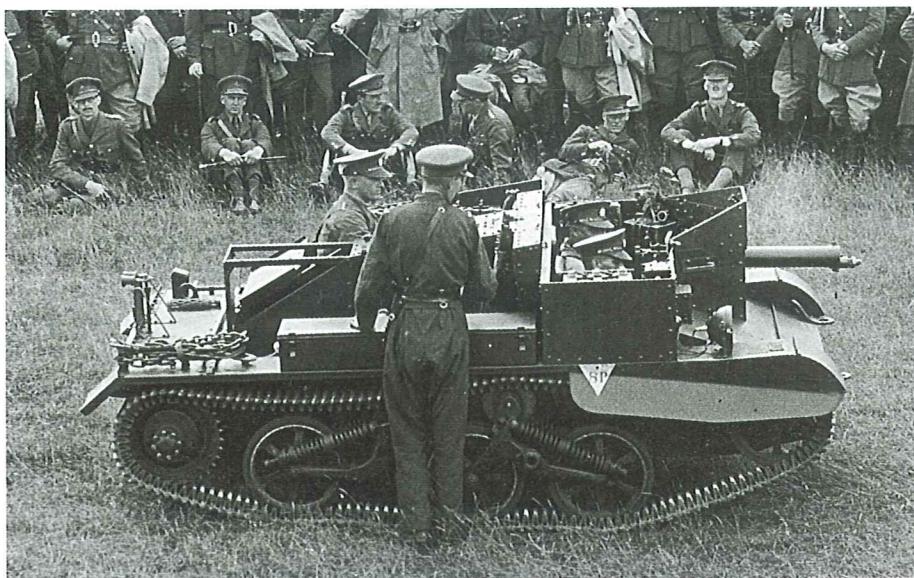


	Weight (tonnes)	1.22	Front Armor (mm)	9mm
Length (m)	2.46	Side Armor (mm)	9mm	
Width (m)	1.75	Engine HP	40	
Height (m)	1.22	Road Speed (km/hr)	40	



Carriers, Pre-War

A range of similar vehicles were developed by Vickers Armstrong during the mid-1930s for specialized roles. The first was the MG carrier to carry the heavy Vickers water-cooled MG for the infantry. The driver sat at the right and the removable Vickers was mounted with a small shield to the left. A seat for a third dismounted crew was provided at the rear. A slightly modified MG carrier was adapted to carry the Bren light MG as the Bren Gun Carrier. The Cavalry Carrier was fitted with unprotected outward-facing seats on each side at the rear for two or three men, while the Scout Carrier was a reconnaissance vehicle armed with a forward-facing Boys AT rifle and a pillar-mounted Bren. Some of the Scout Carriers were fitted with radios in the rear.

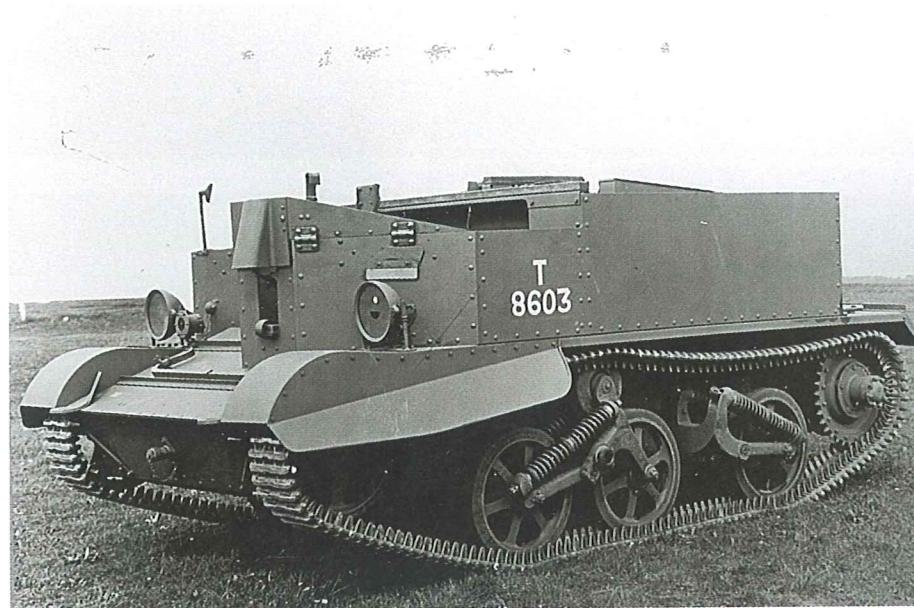


An MG carrier No.2 Mk I in 1938

Carrier, Universal

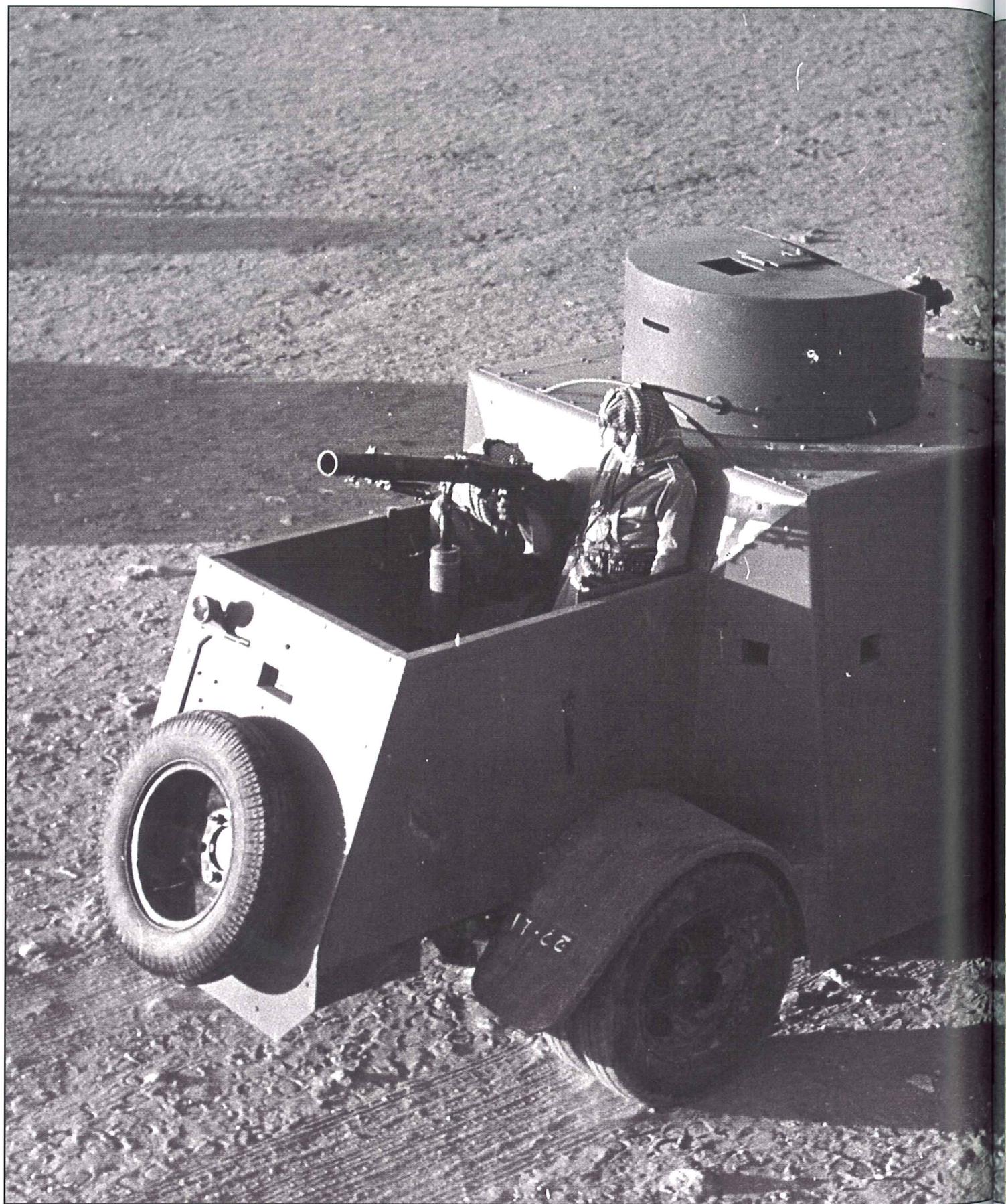
The successor to the various types of pre-war carriers, the Universal Carrier featured a low open-topped hull at the rear that greatly increased its utility. The driver sat at the left front and a gunner on the right. Normally a Bren gun was fitted in that position, but a Vickers gun or a Boys AT rifle could be carried in lieu. In the latter case, the Bren was moved to a pintle mount at the center. The rear compartment could accommodate two more men. Two more specialized variants were developed. The AOP carrier was optimized for artillery forward observers and lacked the weapon port in the front and carried a radio at the right rear. The mortar carrier was designed to carry the 3" mortar with the barrel strapped across the rear, a small amount of ammunition, a driver and four gun crew. These worked in pairs, with one vehicle carrying the mortar and 72 rounds, and a second carrying the rest of the crew and a further 72 rounds.

Universal carrier without armament



	Weight (tonnes)	3.6	Front Armor (mm)	12
	Length (m)	3.66	Side Armor (mm)	n/a
	Width (m)	2.11	Engine HP	65
	Height (m)	1.37	Road Speed (km/h)	50

(data for Bren Carrier No.1)





British Commonwealth & Empire

The Commonwealth provided critical quantities of light armored vehicles during the war, in particular, South African armored cars in 1941-42 and Universal Carriers from 1941 onwards from Canada, Australia and New Zealand. Two nations built tanks, but with no experience in tank construction, by the time they were ready the easy supply of tanks from the United States rendered them superfluous.

Australia

A handful of Vickers medium tanks had been purchased in the 1920s, but these had worn out by the start of the war. A single primitive armored car, designated model LP-1 (local pattern) had been built on a Ford 4x2 truck chassis in 1934 and two further similar vehicles known as LP-2 in 1936.

The situation briefly looked promising when, in the Spring of 1936 an order was placed for ten new Mk VIA light tanks (plus one from British stocks), these arriving in late 1937. On their arrival a second order was placed, this time for 24 Mk VIB light tanks, but this was cancelled shortly thereafter.

Instead, efforts turned towards the production of two more small series of armored cars, the LP-3 and LP-4 models. The former was built on the shortened chassis of a 4x2 Ford 3-ton truck chassis by the Ordnance Factory Maribyrnong with a body made of 6mm armor plate. The LP-4 was similar, but was built by the South Australian Railways Workshop and incorporated a Marmon-Herrington 4x4 conversion. The turret was fitted with a Lewis .303 machine gun and was open at the rear and the top. With their thin armor and marginal cross-country performance the LP-3 and LP-4 vehicles were used only for training until 1942, when they were removed from service.

The most important industrial contribution to the Commonwealth armored inventory was the substantial quantity of carriers built in Australia. Overall they were similar to their British counterparts except that the power plants were imported from North America. Other



JANE'S TANKS OF WORLD WAR II

	1939	1940	1941	1942	1943	1944	1945
Australia							
LP 3 Armored Car	6	-	-	-	-	-	-
LP 4 Armored Car	9	-	-	-	-	-	-
Dingo Scout Car	-	-	-	220	25	-	-
Rover Light Armored Car	-	-	-	198	40	-	-
AC-1 Sentinel	-	-	-	22	44	-	-
Universal (Bren & MG) Carrier	-	160	1,577	2,135	1,086	104	-
Universal (Mortar) Carrier	-	-	-	115	285	-	-
Universal (2pdr AT) Carrier	-	-	-	199	-	-	-
Canada							
Valentine 2pdr Tank	-	-	73	943	404	-	-
Ram Tank	-	-	27	1,100	821	-	-
Grizzly Tank	-	-	-	-	188	-	-
Sexton 25pdr SP	-	-	-	-	424	1,236	462
Ram OP Tank	-	-	-	-	84	-	-
GM Armored Car	-	-	-	276	841	6	-
Ford Scout Car	-	-	-	902	1,407	761	185
Otter Reconnaissance Car	-	-	-	1,129	632	-	-
Universal (Bren) Carrier	-	-	2,927	8,595	9,429	6,601	104
Universal (Mortar) Carrier	-	-	-	188	1,053	95	-
Windsor Carrier	-	-	-	-	-	2,006	2,989
India							
Wheeled IP Carrier	-	-	656	1,460	1,842	-	-
Armored Car IP Mk III	-	-	-	202	74	-	-
New Zealand							
Beaverette	-	-	-	207	-	-	-
Universal (LP2) (Bren/MG) Carrier	-	-	46	683	481	-	-
South Africa							
Marmon-Herrington I	135	-	-	-	-	-	-
Marmon-Herrington II	-	887	-	-	-	-	-
Marmon-Herrington III	-	-	1,368	1,210	-	-	-
Marmon-Herrington IV	-	-	-	348	1,355	413	-

Commonwealth AFV Production 1939-45

differences between the Australian models (known as Local Pattern) and the originals included revised stowage and some different components. Two local versions were the 3" mortar and anti-tank carriers. Both mounted the weapon on a turntable that permitted 360° traverse.

The first substantial contribution to Australia's tank force came with the fall of the Dutch East Indies in March 1942. Cargo ships carrying 50 M3 light tanks and 148 Marmon-Herrington CTLS light tanks were diverted to Australia and the vehicles taken over by the Royal Australian Armoured Corps. The M3s complemented ten similar vehicles already shipped from the US for familiarization, but the little Marmon-Herringtons were suitable only

for limited training and were scrapped after about a year.

Formation of an armored division had actually begun in July 1941, albeit without equipment. That was to change the next year, when 270 M3 light tanks and 777 M3 medium tanks were shipped from the US as the Australian allocation of British Lend-Lease. A further 45 lights arrived the following year. This was to permit the formation of two additional armored divisions.

Minus 20 that were shipping losses, the mediums were about equally divided among M3 Grant (gasoline), M3 Grant (diesel) and M3 Lee (gasoline). The basic M3 Grants (gasoline) were the first to arrive, starting in March/April 1942. The most common of the

233 diesel-engined Grant was the M3A5, although some M3A3s were also delivered. Both long-barrel and short-barrel 75mm guns were fitted to portions of the fleet.

The Lee/Grants were destined to see no combat, although they continued to serve into the 1950s in Australia. Instead, attention was focused on the need for an infantry tank for use in the Pacific. In early 1942 the British released 140 Matilda II tanks and these began arriving in April. By the end of the year 304 were on strength in Australia. The Matildas proved very useful, if somewhat undergunned, in jungle operations against the Japanese and only 27 of the Matildas were the CS version with the 3" howitzer. By 1944 they were worn out and in March the 33 New Zealand Matilda CS tanks (18 without guns) were purchased. The 18 disarmed Matildas were fitted with "Frog" flamethrowers in June 1945 and used effectively on Borneo.

With a potential deployment to Europe for one of the armored divisions still in mind, approval was granted by the government for the purchase of 310 Shermans, but no action was taken and in March 1944 the funds had expired. A second request was immediately submitted, but this time specifying the Churchill as the preferred tank with an eye towards operations in the Pacific. An order for these tanks was finally placed, but the first vehicles did not arrive until after the war was over. Also included in the second request were about 70 M24 light tanks from the US, but this was withdrawn after it was pointed out that light tanks actually had little value in the island fighting of the Pacific.

An effort was made to develop and produce an indigenous tank. With external sources of supply few, the General Staff drew up a requirement in November 1940 for a 16-20 ton vehicle with a 2pdr gun and 50mm of armor. After some false starts resulting from a lack of suitable automotive components, a prototype AC-1 (Australian Cruiser 1) was completed in January 1942. The vehicle was remarkable in that a country with no previous tank manufacturing experience had turned out a vehicle with a well-shaped one-piece cast hull and an ingenious clover-leaf coupling of Cadillac automotive engines. Nicknamed the Sentinel, the AC-1 was a testament to Australian ingenuity. Unfortunately, by the time

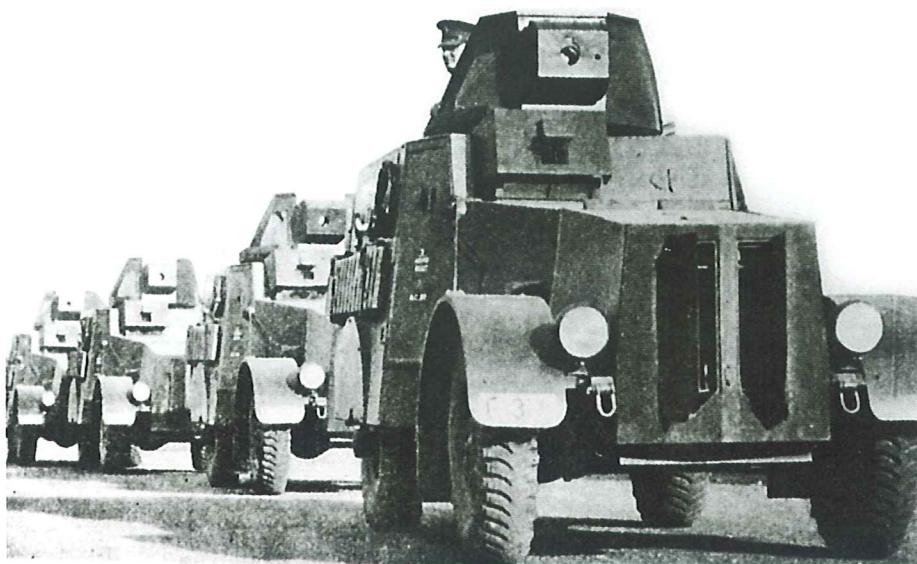


Right: Two-thirds of the Australian fleet of LP3 armored cars on parade, 1939 (PMK).

it started coming off the production line in series in August 1942 the concept of a 30-ton tank (to which the weight had now climbed) armed with a 2pdr gun was hopelessly obsolete. A prototype AC-3 (with a 25pdr gun-howitzer) was built, as was an AC-4 (set up to receive a 17pdr), but by then ample supplies of foreign tanks had become available and it was felt that Australian heavy industry could be put to better use. As a result, production of the AC-1 was terminated in July 1943 and no production of the later marks was undertaken.

For lighter armored vehicles indigenous development and production was the order of the day. An armored division would require 210 scout cars as its initial complement and the Department of AFV Production and Ford Motor Company collaborated on a local design based on the Dingo, a shortened version of the Ford 15cwt truck chassis converted to four-wheel drive. A mild steel prototype was completed in November 1941 and a production order was awarded in February 1942. The vehicles were built by Ford at Geelong using hulls from the Victorian Railways Workshops. Once production was complete a modification program to reduce weight was begun, but was never implemented as by that time emphasis had shifted to the jungles of the Pacific, where such vehicles were not very valuable.

Following shortly on the heels of the Dingo was the Rover light armored car. Design work was begun in late 1941 and an experimental model completed in January 1942. Based on test results with this vehicle, series production was ordered and began a month later. In configuration the Rover was actually closer to the IP Wheeled Carrier than to any armored car. It had a long, thin semi-open-topped boat-shaped body with the driver and commander at the front, two gunners facing outwards in the crew compartment, and a radio operator. It lacked a turret and its armament of three Bren or Vickers guns was fired through ports in the front and side plates. The vehicles were based on the Canadian Military Pattern 4x4 3-ton truck chassis, with 198 using the short wheelbase and the balance the long wheelbase model. Although maximum armor thickness was only



16mm, the vehicle was overloaded and sluggish, and the crew compartment was found to heat up alarmingly in operation. It was declared obsolescent in 1944 and gradually withdrawn from service.

The Dingos and Rovers were replaced by imported wheeled vehicles. The first to be delivered were M3A1 scout cars, of which 503 eventually arrived. In March 1944 the first batch of Staghound armored cars arrived, followed by 97 more by August. Also delivered were 171 Canadian scout cars.

The most numerous of the Australian armored vehicle families was the Universal Carrier. A Bren Carrier No.2 Mk I was purchased from Britain and delivered in mid-1939. From this plans were drawn up for a "local pattern" (or LP) version, using a more easily-available Canadian Ford engine and transmission, simplified by using brake steering only. A total of 160 vehicles, known as the LP1 carrier, were built by Victorian Railways in the second half of 1940. They were declared obsolete in late 1941.

Engine overheating and brake failures, consistent problems with the LP1, were remedied with a new design, the LP2 and LP2A, based generally on the Universal Carrier. The new model also reintroduced track-displacement steering, not included in the LP1. Armament was supposed to be the Bren light MG for vehicles destined for overseas service and the Vickers for vehicles remaining in

Australia, but this was not strictly adhered to, and other weapons, such as the Boys AT rifle and Lewis MG, were also sometimes fitted. The initial order covered 1,852 vehicles and was placed in August 1940, with deliveries starting in early 1941. Five firms built LP 2/2A carriers and production quickly ramped up, so that further orders were placed for 881 in 1941 and 1,100 in 1942, along with an export order for the Eastern Supply Group for 2,000 in late 1941. In July 1943 the War Cabinet decided to terminate carrier production for the Australian Army. The inevitable delays ensued and deliveries finally ceased in the Autumn, although units for export remained in low-rate production. A further improvement, the LP3 carrier, was trialled in prototype form in 1944 but no orders were placed.

Two specialized variants of the LP2 were developed as well. To create an anti-tank vehicle the LP2A chassis was lengthened by 22cm and improved engine cooling fitted to create a light tracked vehicle with an open rear bed. To this was mounted the 2pdr AT gun complete with shield. An order for 200 was placed in February 1942 and deliveries took place between May and October 1942. An additional order for 106 was cancelled when it became apparent that the 2pdr was no longer an effective anti-tank weapon and the unprotected crew would be vulnerable in jungle fighting.

For HE fire support the Metropolitan Gas Company, builder of the 2pdr carrier, took the



Left: Australian AC1 Sentinel (PMK)

chassis of the 2pdr carrier, added low walls to the rear bed and replaced the 2pdr gun with a 3" mortar on a turntable to create the 3" Mortar Carrier. An order for 400 was placed in mid-1942, to begin on completion of the 2pdr carrier order. The first was delivered in October 1942 and the order had almost been completed in March 1943, when the Army decided they had no requirement for these vehicles after all. The last of the 400 vehicles came off the line in June 1943 and all were shipped to India for distribution to the Chinese.

Canada

The 1936 reorganization of the Army converted six Militia infantry battalions to tank battalions and a further four to armored car battalions. No thought, however, appears to have been given to actually equipping these formations, for the only armored vehicles available were 12 Carden-Loyd Mk VI machine gun carriers purchased in 1934, along with the anticipated delivery of 16 Mk VIB light tanks purchased from Vickers in 1936.

On the outbreak of war Canada offered military units to Britain, including tank units, but the British had no interest in tank units without tanks. On 27 May 1940, with the battle for France in full swing, Britain asked Canada if they could produce the new Valentine tank. The next month saw cabinet approval for 488 tanks to equip a Canadian tank brigade, along with training issue and replacements. The Canadian Pacific Railway shop in Montreal was quickly selected to build the Valentine III tank, but substituting the locally available GM diesel as

the powerplant. After some frustrating delays the first production Valentine was delivered in early August 1941. The initial batch were Valentine VI (the Valentine III with GM diesel, also adopted by the British as the Valentine IV), which were then replaced by the Valentine VII with detail changes. The main difference between the British and Canadian Valentines, was the use of the Browning .30cal machine gun in the latter, as opposed to the Besa in the original. Production of the Valentine by CPR was completed in early 1943 but it was never used in combat by Canadian (or even British) forces. Instead, except for 30 machines held for training, the entire output was purchased by Britain and shipped to the Soviet Union in fulfilment of their Lend-Lease agreements.

Even while the CPR was tooling up, Canadian observers went south to look at US

developments. One of their missions was to find training tanks, and to this end they purchased 250 M1917 tanks (US copies of the FT), which were used for training until 1942. They also examined the M2 medium tank and saw drawings of the M3 medium. They were impressed by the automotive components and the 75mm gun, but less taken with its location in the hull. Montreal Locomotive Works built a wooden mock-up of a tank with the automotive gear of the M3, but with a cast hull, curving armor and a turret mounting a 6pdr gun. An order was placed and the first prototype Ram tank was delivered in April 1941, the same time as the first American M3. As with the Valentine, production of a tank proved more difficult than envisioned and, in particular, the production of tanks far outstripped that of their armament. The first 50 Rams were produced with the 2pdr gun, but subsequent vehicles were armed with the 6pdr as the Ram II. Of the Rams, 277 were retained in Canada for training, 104 were lost at sea and the remainder arrived in the UK for use by Canadian forces.

At the end of 1943, 446 Rams were turned over to the British who converted about half into recovery vehicles, and about a third into APCs. Of those still in Canadian hands about 300 were converted into APCs and ammunition carriers, and the British accepted a further 300



Right: Canadian Shermans in the Netherlands, 1945



Right: Canadian Otter reconnaissance cars, used by the RAF Regiment in Greece, 1944.

Rams for use in both Italy and NW Europe as APCs and recovery vehicles. Of the Canadian APCs, 36 were equipped with Wasp flame throwers, while another 59 Rams were converted into towing vehicles for 17pdr AT guns.

By the time the Ram II reached full production, however, the US was producing the M4 Sherman with its 75mm gun. The decision was therefore made to switch to production of a slightly modified version of the M4A1 known as the Grizzly. As the US was already producing enough Shermans, Grizzly production was halted at 188 between September and December 1943. The hull, however, was kept in production for SP artillery. The Canadian Tank Brigade was issued with Churchills on its arrival in the UK, converted to Rams briefly, and then to Shermans for its operations in Sicily. The tank chosen for the Canadian Army was the Sherman V (M4A4) and this was the standard tank for the 2nd Armoured Division, but other units were often equipped with Sherman III (M4A2) due to supply difficulties.

Indeed, it was as conversions and derivative vehicles that the Ram saw its combat. Designed by the Canadian Army Engineering Design Branch, the Sexton mounted a 25pdr gun on the chassis of the Ram in a manner similar to that of the US M7. The result was highly successful and it was adopted as the standard SP artillery by the British Army, replacing its M7s in NW Europe. Sextons in the UK were also converted to GPO (gun position officer) vehicles as command vehicles for artillery units by removal of the gun. A plan to build 250 Skink AA vehicles on the Grizzly chassis was abandoned.

The adoption of the Sexton left the Canadian Army with 72 surplus M7s, which they converted to armored personnel carriers. These proved so useful that when they began to wear out a program for conversion of Ram tanks to the APC role was undertaken. These were very popular vehicles and served to the end of the war in a special unit, the 1st Canadian Armored Carrier Regiment.

The delays that afflicted much of Canadian AFV production were not evident in the case of



the Universal carrier. In this case they turned the program over to masters of mass production, Ford of Canada. Production ramped up quickly, and was only phased out to bring in the larger Windsor carrier. The Windsor replaced the Loyd carrier as the preferred mover for 4.2" mortars and 6pdr AT guns in Canadian forces in Europe.

Although most of the Canadian auto industry was of American parentage, local design and development staffs were competent and creative. The CMP (Canadian Military Pattern) family of softskin vehicles were reliable and popular. It is thus somewhat surprising that their efforts at wheeled armored vehicles were less than impressive. In part, this resulted from the attempt to adapt British-style vehicle structures to Canadian chassis and automotive components, yielding products that betrayed both lineages.

The decision to build an armored car in Canada seems to have come in late 1940, and in September 1941 the decision was made to mount the hull of the Humber IV on a GM 4x4 truck chassis. Changes in requirements and lack of proper Humber drawings yielded a vehicle that, when completed, was considerably overweight. Weight reduction efforts were only partially successful, and the vehicle remained overloaded through its life, and by late 1943 was regarded as "inadequate". It was only briefly used by Canadian forces in Sicily before being replaced by T17E1 Staghounds in the two armored car regiments, and Daimlers and Humber IVs in the infantry division reconnaissance regiments.

In January 1941 a British Daimler scout car was delivered to Ford of Canada, and they proceeded to develop their own version, simpler with a conventional frame and chassis. Once again, the resultant vehicle, known as the Lynx, was overweight with predictable consequences to reliability. In September 1943 go-ahead was given to produce the Lynx II which eliminated some, although not all, of the faults of its predecessor. The Canadians initially used Lynx I scout cars, these being mostly replaced later on by Lynx II and British models.

The third Canadian wheeled AFV was the Otter, a light reconnaissance car expected to be analogous to the British Humber Ironside. Production began in February 1942 and, once again, it proved overweight. Use in Sicily highlighted the resultant suspension problems and modification kits to alleviate the worst of these were provided in late 1943. The fix was not entirely successful, and by 1944 they had been relegated to service units, with the Humber III light reconnaissance becoming the standard in the Canadian Army.

New Zealand

The New Zealand Army had no armored vehicles until the arrival in April 1939 of six Bren Carriers from Britain, which were distributed in two-vehicle sections to three of the nine mounted rifle regiments in the process of motorization.

The decision to form the 2nd NZEF for overseas service as a full division to British establishments was made in September 1939, with the British agreeing to equip it on arrival.



JANE'S TANKS OF WORLD WAR II



Left: A local New Zealand pattern Beaverette.

Thereafter the 2nd NZ Division, although manned and led by Kiwis, was a British division in organization and equipment, receiving its arms and supplies directly from British stocks in the Middle East. The divisional cavalry regiment arrived in Egypt in February 1940 and was equipped to the usual British standards of 44 carriers and 28 light tanks (mostly early marks, such as Mk III). The regiment received some Marmon-Herrington armored cars in early 1941, but lost all their equipment in Greece shortly thereafter. They then reequipped with Mk VIB/C light tanks and in early July 1942 they received 15 Stuart tanks. In July 1943 the regiment was re-equipped as an armored car regiment, with three squadrons, each of five troops of Staghounds and one of Dingo scout cars. In short order a modification kit was developed that permitted one Staghound in each troop to be rearmed with a 3" howitzer in lieu of the normal 37mm gun. The cavalry regiment was the sole armored element of the division until July 1942, when the 4th (Infantry) Brigade was withdrawn for conversion to armor. The three infantry battalions were converted to armored regiments, each with 52 Sherman tanks. The armored brigade returned to the division in early 1943 and served throughout the Italian campaign. Short of infantry, the cavalry regiment was converted to foot soldiers in late 1944.

While the British willingly supplied armored vehicles for use in the Middle East, some coaxing was needed to get them for the defense of far-away New Zealand. Attempts starting in January 1940 to purchase carriers from Australia foundered when production there was delayed and in August an order was placed with Hutt workshops for the local construction of 40 Bren gun carriers (in mild steel), known as LP (local production) 1. This was only the beginning, for simultaneously, an order for 200 welded carriers (LP 2) was placed with NZ Railway, this being raised to 420 in October, with General Motors taking over the lead. In April 1942 New Zealand raised its requirement to 520. These were based on the Australian LP2 carrier, of which a prototype had been acquired. The first 454 were built to accommodate the Vickers gun, later vehicles the Bren gun. In August 1941 the Eastern Group Supply Council, in Simla, India, placed an order for 650 carriers based on the Australian LP2A, which became known as the NZ LP2A, featuring room for a radio. The EGSC never took delivery of the vehicles, of which 200 were rebuilt LP2 models, and many went into storage until after the war. The LP2As were built in four configurations: Vickers carrier, 3" mortar carrier, 6pdr gun tractor, and flame-thrower. Imports of carriers from the UK totalled 54 universal carriers, 111 mortar carriers and 21 Lloyd carriers, all in 1941-42.

A simpler and cheaper armored vehicle was the Beaverette, based on the British vehicle of the same name, but larger by virtue of using a Ford truck chassis in lieu of a car chassis. Two prototypes were built in 1941 and in early 1942 the Hutt Workshops version was chosen with an order 187, later raised to 207. The NZ Beaverette used the chassis of the Ford 4x2 1-ton commercial truck chassis and was to have been protected by 13mm hardened steel. Armor plate, however, proved impossible to acquire, so instead they used mild steel acquired from wrecked ships and oil pipes. The NZ Beaverette had a crew of two and was armed with either a Bren Gun or a Boys AT rifle. The carriers and Beaverettes were distributed to the Light AFV Regiments (former mounted rifle), and carriers were also issued to the carrier platoons of the infantry battalions in New Zealand and the Pacific.

Small numbers of other wheeled vehicles were also acquired but do not appear to have seen extensive use. Ford assembled 45 India Pattern II wheeled carriers in 1943 for use by forward observers, but these were too late to see much service. In addition, the US provided 95 M3A1 White scout cars in 1942, but these were disposed of in 1943-44. Britain supplied 84 Daimler Mk II scout cars in 1942-43, and these were more successful, serving until the early 1960s.

In July 1941 approval was given for the formation of the NZ Army Tank Brigade at home and in October the British shipped 30 Valentine II tanks as a training scale, but nothing further could be spared. Shortly after the Japanese declaration of war, orders were placed in Britain for a further 306 Valentines and 34 close-support Matildas to equip the Brigade with 156 Valentines and 18 Matildas, plus a 90% reserve. To re-equip the light AFV regiments an order had been placed in the US for 170 M3 Stuart light tanks, and this was increased to 731 in March 1942.

During 1942 the British supplied 236 Valentines: 70 Mk II, 74 Mk III, 81 Mk III and 11 bridgelayers, along with 33 Matilda IV CS support tanks. In December 1942 the tank brigade was broken up, leaving only the 2nd Tank Battalion as an operational unit. This unit



was equipped entirely with Valentines, and in the end only "C" Squadron saw combat in the Pacific. To maintain the homogeneity of the battalion, the 3" howitzers were removed from 18 of the Matilda CS tanks and installed in Valentine IIIIs, a conversion that proved satisfactory. The 33 Matildas (including 18 without guns) were handed over to Australia in 1944.

The Stuarts present a more complex story. The first batch of 292 Stuarts began arriving in June 1942 and immediately proved difficult to bring into service. Initially this was ascribed to the fact that no publications had arrived with them, but it subsequently turned out that these were a very unusual combination of M3 hulls and M3A1 turrets, but without the M3A1 turret baskets. Because the hull/turret electrical connections were different on the two models, these tanks, known as "Hybrid Stuarts", had no electrical power to the turret. Attempts to improvise solutions to the myriad problems presented proved only partially successful, and they were never considered satisfactory vehicles. In the spring of 1943 the US shipped 89 M3A1s, but these never completely supplanted the earlier models in service. Neither type was used in combat.

South Africa

The Union of South Africa's armored inventory at the start of the war consisted of two very tired Crossley armored cars and two Vickers medium tanks purchased in 1925. The terrain of much of South Africa made armored cars an attractive proposition and local designers began an early, if poorly-supported, effort to develop an indigenous vehicle in 1937. Initial efforts yielded the Reconnaissance Car Mk 1, consisting of a large armored body surmounted by a turret carried on an imported 3-ton Ford 4x2 truck chassis. By the time the war had broken out, experiments had been conducted with the Marmon-Herrington conversion kit that turned the Ford 4x2 into a four-wheel drive vehicle. The superiority of this arrangement led to orders being placed for almost 890 of these vehicles, but the supply of conversion kits would be slow, so an initial order for 135 of the Mk I vehicles was placed as well. The Mk Is were

delivered starting in May 1940 and completed near the end of the year.

The Mk II with four-wheel drive was almost identical externally to the Mk I, but quickly transitioned from riveted to welded hull construction. The Marmon-Herrington Mk II¹ was built in two configurations, differing in their armament. One batch (549 vehicles) were designated as Mobile Field Force (MFF) vehicles and carried one Vickers machine gun in the turret and a second in the left hull side. The other batch (338 vehicles) were known as Middle East (ME) vehicles and carried a Bren gun and an anti-tank rifle in the turret, and a second Bren gun on an AA mount.

A further improvement came with the Mk III, for which the chassis was shortened. The reduced wheel base improved cross-country performance and the shorter hull allowed slightly thicker armor to be employed with no increase in weight. Once again two variants were produced, an MFF (1,780 vehicles) and ME (798), featuring the armament distinctions of the Mk II. The Mk I vehicles were used operationally only in Ethiopia, but Mk II and Mk III vehicles saw extensive service, including the Middle East, where they formed the bulk of the British armored car strength from late 1941 to mid 1942. During the second half of 1941

Below: Mk II mounting captured Italian 47mm gun (PMK).

South Africa delivered 129 Marmon-Herringtons to the Middle East, 66 to India, 102 to East Africa, 19 to West Africa, 49 to the Netherlands East Indies, 10 to the Free French in Chad, and 175 to Malaya. In the first half of 1942 they delivered a further 261 to the Middle East, 189 to India, and 48 for the Free French in the Middle East. Even with the deliveries of more modern vehicles, by the end of October 1942 the Middle East theater's inventory of armored cars totaled 1,473, of which 786 were Marmon-Herringtons.

The Mk II and III vehicles were clearly reaching obsolescence by late 1941. Their replacement, the Mk IV, was to be a completely new design. It featured a unibody hull (albeit still using Marmon-Herrington drive components) with a turret mounting a 2pdr gun. To speed production, most of the vehicles (some 1,180) were actually built with Ford, instead of M-H, components and these were known as the Mk IVF. Production switched from the Mk III to the Mk IV in July 1942, although completion of the Mk III order took a few more months to taper out completely. The Mk IVFs were purchased by Britain, but appear



¹All South African armored cars were universally referred to as Marmon-Herringtons, that designation even being retrospectively applied to the Mark I, which did not have the Marmon-Herrington conversion kit. The South Africans referred to these vehicles officially as "reconnaissance cars", while the British called them "armoured cars".



JANE'S TANKS OF WORLD WAR II

to have seen no combat service, while the Mk IV vehicles stayed in South Africa.

Reports of a massive German 8x8 armored car led South Africa to develop its own versions, the Marmon-Herrington Mk V in 1942 and the Mk VI in 1943. The Mk V was a failure and the Mk VI only a little better, and neither entered production.

After the fall of Tunisia the South African forces in North Africa were brought home and a new formation, the 6th Armoured Division, was formed. It was sent to Egypt, where it picked up the equipment issue of a British armored division, including Sherman tanks for three battalions, and moved to Italy, where it fought to the end of the war.

India

Britain maintained eight RTC armored car companies in India during the 1920s and 1930s, with their most active service being on the NW Frontier. Although these were British units, the Indian government was required to pay for their equipment and in 1921 they ordered 19 Rolls-Royce IP (India Pattern) armored cars, followed the next year by an order for 32 Vickers vehicles mounted on 4x2 Crossley chassis. A second order for Crossleys was placed in 1925, probably for about 70 vehicles. A batch of 20 big Guy 6x4 armored cars was ordered in 1927. Proving too large and unwieldy for narrow Indian roads, they were withdrawn from service in 1934.

As the British began losing interest in armored cars in favor of light tanks, so too did the Indian government. In 1929 they ordered four Light Tanks Mk IA from Vickers and these were delivered and trialled in 1930-31. They were successful and a series production contract for 54 Mk IIB IP light tanks was placed in late 1931. The proved underpowered, and the next contract, placed in early 1933, called for 29 Mk IVA light tanks, with a slightly higher power-to-weight ratio. By 1936 it had been decided to convert the armored car companies to tank companies, resulting in significant orders for the Mk VIB light tank. The first 60 were ordered in mid-1936, followed by 33 more a year later, then a further 51 a year after that. As the tank companies acquired their vehicles the old armored cars were handed over to the Indian Army who, starting in 1939, transferred some of

	1941	1942	1943	1944	1945
Light Tanks	32	545	327	2	300
Medium Tanks	-	896	289	337	48

US Export of Tanks to India

the RR and most of the Crossley bodies onto new 1-ton 4x2 Chevrolet chassis. The latter became known as Chevrolet TG-130 armored cars. In October 1939 the British companies were withdrawn and handed the remaining armored cars and the light tanks to two Indian frontier regiments. The light tanks served on the frontier until 1943, while the Chevrolet armored cars served on into 1942 with Indian forces in Persia/Iraq.

A pressing need was for a light, armored, utility vehicle, analogous to the British universal carrier. The tracked solution was rejected, probably due to cost and manufacturing difficulties, as well as the large operational area occupied by the Indian Army. Tata Iron Works was capable of building armored hulls, and in 1940 they built ten prototypes for fitting to front-engine Ford chassis modified with a Marmon-Herrington conversion to 4x4 configuration. This vehicle, the Carrier, Wheeled, IP Mk I, was followed by the main production version, the Mk II, using a rear-engine Ford 4x4 chassis imported from Canada. The wheeled carriers proved useful machines in the Middle East and Persia/Iraq theaters, and were used in smaller numbers of Indian forces in Italy.

In 1942 a roof was fitted to some of the vehicles and a turret mounted, this carrying a Bren gun and an AT rifle. In this configuration the vehicle was known as the Armored Car Mk III. An order for 300 was placed, but was terminated slightly early. A further evolution into the Armored Car Mk IV, mounting a 2pdr gun, was designed but the gun mounts, to be imported from Britain, proved unavailable and the full production was dropped.

Indian Army tank units were equipped entirely with American tanks. The first two regiments converted in India in late 1941 and by May 1942 were fully equipped with one squadron of M3A1 Stuarts and two squadrons of M3A5 Grants and/or M3A1 Lees. The next two regiments were converted in the Middle East, starting in April 1942. By November one was fully equipped with M3A1 Stuarts and the other with Grants. In early 1943 three more

regiments in India were converted, all as Stuart light tank regiments. In late 1943 the two in the Middle East had been re-equipped with Shermans, while the two original units in India were similarly re-equipped in June 1944. At the same time, an armored car regiment was also converted to Shermans. Thus, at the end of the war the Indian Armoured Corps held eight tank regiments, five with Shermans and three with Stuarts. All three types, Stuarts, Grant/Lees and Shermans, were used in the fighting in Burma. The British Army tank regiments that formed part of the Indian armored divisions and brigades used Valentines, Stuarts and Grant/Lees.

The armored car and reconnaissance regiments initially received a heterogeneous mixture of vehicles. Marmon-Herrington Mk II and Mk III armored cars were issued to one regiment in Persia and one in the Middle East. The recon regiment, shipped to Malaya, picked up 30 old M-H Mark IIs when they arrived there in late 1941. Supplies of Daimlers and Humber began trickling in in 1941. By 1943 most of the regiments had been reequipped with Daimler and Humber III and IV armored cars. One regiment in the Middle East reequipped from Humber to Staghounds in November 1943. In that theater, one Daimler/Humber regiment included a heavy troop with eight 75mm-equipped Staghounds, while the other used M3 half-track 75mm SP guns.

The three motor regiments were initially formed with trucks, but in February 1942 two of the squadrons in each were reequipped in the Middle East with 15 universal carriers apiece. The regiments were disbanded a year later.

The infantry divisional motor cavalry regiments were also initially equipped with trucks. Those arriving in the Middle East each received a platoon of universal carriers, while the two in East Africa each got universal carriers for one platoon in each squadron, which they promptly used to form a carrier squadron in each regiment. Universal Carriers were also used to form a carrier platoon in most infantry battalions.



British Colonies

Arab Legion

Approval for the granting of a mechanized regiment in this force was granted in December 1940, which included an armored car squadron of 12 vehicles. Ford truck chassis were acquired and fitted with armored bodies locally.

Protection consisted of two layers of mild steel separated by a sheet of plywood, but this apparently proved satisfactory in the low-threat local environment. Each car carried a turret mounting a Vickers MG and an AT rifle, and a Bren or Lewis gun was carried for air defense. In November 1941 the force was expanded to three mechanized regiments with a new organization taking advantage of additional Ford armored cars built. South African armored cars gradually replaced the Fords and each regiment now had two armored car squadrons with a total of 30 Marmon-Herrington III armored cars and a reconnaissance platoon with 12 M-H II armored cars. Both models were replaced by M-H Mk IV armored cars in late 1943 and early 1944.

East Africa

The King's African Rifles converted their machine gun battalion to a reconnaissance battalion in January 1942 and later that year it acquired used Marmon-Herrington armored cars. Shortly thereafter it was redesignated the 3rd East African Armoured Car Regiment and joined by a new 4th EAAC Regiment. Thus, by October 1942 there were 225 M-H Mark II & III armored cars in East Africa, along with 77 Universal Carriers for the infantry battalions. In

Right: A Ford armored car of the Arab Legion in early 1942 (George Rodger/Timepix)

1944 the M-H armored cars were replaced by M8 Greyhounds. Neither regiment left its home base.

Malaya

About a dozen locally-built armored cars based on truck chassis were in use in the late 1930s with various volunteer forces, but most of these appear to have been used up by the start of the war. A shipment of 22 old Lanchester armored cars arrived in 1939 and these were distributed to two armored car companies: one of the Singapore Volunteers, and the other of the Federated Malay States Volunteer Force. Some were also handed over to a few of the infantry battalions on garrison duty to form improvised armored car platoons. In early 1941, 175 Marmon-Herrington Mk III MFF armored cars were delivered. These were similarly distributed to volunteer forces and infantry battalions.

Somaliland

The Somaliland Camel Corps held no armored vehicles before the occupation of their area by

Left: Ford armored cars of the SDF. In these, at least, the Bren gun has been replaced by a Vickers (PMK).

the Italians in 1940. Following its reconstitution in mid-1941 an armored car squadron was included, using an unknown type of vehicle armed with two light MGs. It had been planned to convert the SCC to an armored car regiment, but a bloodless coup in mid-1944 led to its disbanding instead.

Sudan

Although not a colonial force in the strict sense, the Sudan Defence Force was commanded by British officers and is included here. The force initially included three, later five, motor machine gun companies that used Ford pick-up trucks to carry their Vickers MGs. Shortly before the war they acquired two old Rolls-Royce armored cars, and later they extemporized 45 armored cars using Ford 1-ton 4x4 chassis and homemade armored shells. Each of these carried a low, open-topped turret with a Bren gun and an AT rifle. From September 1944 each of the ten infantry battalions was authorized 28 Universal Carriers.

TransJordan Frontier Force

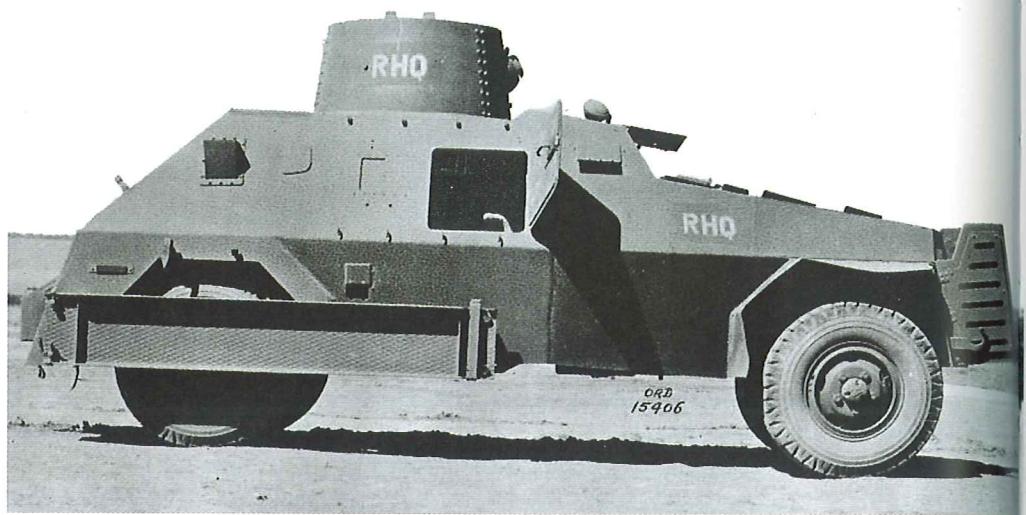
The pre-war TJFF included two mechanized companies with pickup trucks. In January 1941 the two were combined to form the Mechanized Regiment. Each of the mechanized squadrons now consisted 20 local-pattern armored cars armed with light MGs and AT rifles, but no radios. In May 1943 the mechanized regiment was converted to a motorized infantry formation, losing all its armored vehicles.





Marmon-Herrington Armored Cars

The first armored car to be designed and built in South Africa, the Mark I Reconnaissance Car, mated a Ford chassis and powertrain, purchased in the US, with an indigenous armored body. The chassis chosen was that of the 3-ton 4x2 truck, a common building-block that guaranteed cheap and easy supply. The armored body was rather bulky and followed the truck pattern of placing the engine in the front, with the driver behind it, and the crew compartment at the rear. A circular turret surmounted the body, fitted with a .303 Vickers machine gun. A second such weapon was fitted, inexplicably, on the left side of the hull. The limitations of the 4x2 drive system were readily apparent, and efforts were made to acquire Marmon-Herrington 4x4 conversion kits, but this would take some time, so an initial small batch of Mk I vehicles was produced with deliveries in mid-1940.



Above: A Mk II MFF armored car

Below: Mark III





Once the conversion kits became available production began on the Mk II version. Only detail changes were made to the body compared to the Mk I. There were two variants that differed in armament: the MFF was intended for use in South Africa and was armed with a Vickers, while the ME (Middle East) version could take a variety of weapons, such as the Boys AT rifle, Bren light MG, twin Lewis MGs, etc. In the desert they were often fitted with captured weapons, including the 20mm Breda and the German 37mm Pak. The Mk III was similar, but had a slightly shorter wheelbase, improved armor, and a turret with a Boys AT rifle and a coaxial Vickers MG.

The Mk IV was an entirely new design, featuring a rear-mounted engine and an open-topped turret with a 2pdr gun and coaxial MG. The Mk IVF was similar, but used Canadian Ford components instead of Marmon-Herrington.



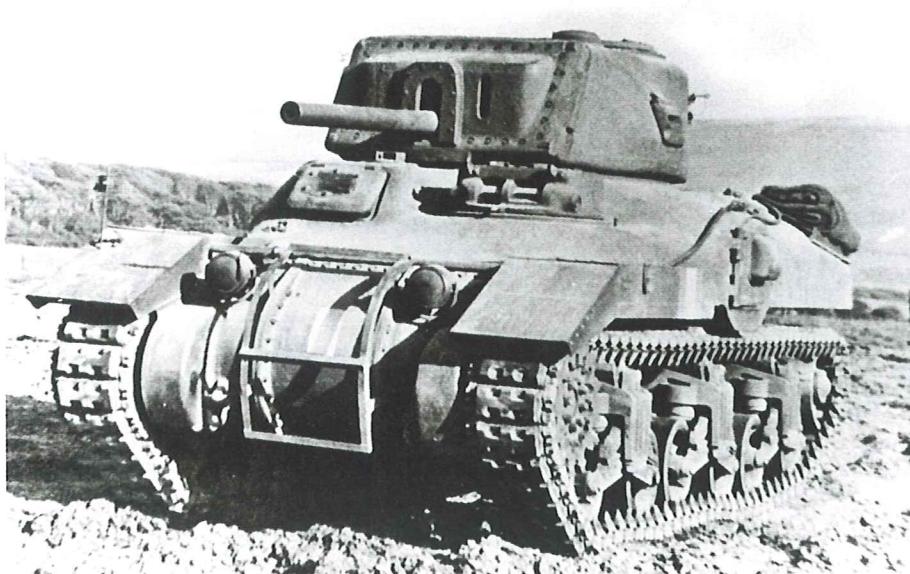
Above: Mark IV (PMK)

Weight (tonnes)	Mark II	Mark III	Mark II	Mark III
Length (m)	5.4	5.4	Front Armor (mm)	12
Width (m)	5.21	5.30	Side Armor (mm)	n/a
Height (m)	1.98	2.29	Engine HP	85
	2.44	2.49	Road Speed (km/h)	83

Weight (tonnes)	Mark II	Mark III	Mark II	Mark III
Length (m)	5.4	5.4	Front Armor (mm)	12
Width (m)	5.21	5.30	Side Armor (mm)	n/a
Height (m)	1.98	2.29	Engine HP	85
	2.44	2.49	Road Speed (km/h)	83

Tank, Ram

The Ram used the automotive components and lower hull of the US M3 medium, mated with a new upper hull and turret of Canadian design. The first 50 vehicles were known as Ram Is and mounted a 2pdr and a coaxial Browning .30cal in the turret, together with a second MG in the small secondary turret on the left front of the hull, and a third on an AA mount. The Ram II replaced the 2pdr with a 6pdr gun. Later vehicles eliminated the MG turret and side doors. It proved impossible to regun them with 75mm so they were obsolete by the time they entered large-scale service. They never saw combat as tanks, but were widely and successfully used as APCs, with the turret removed and carrying 11 infantrymen. In this configuration the secondary MG turret proved useful. They were also converted to OP tanks, towing vehicles for 17pdrs, and to ammunition carriers for the Sextons.



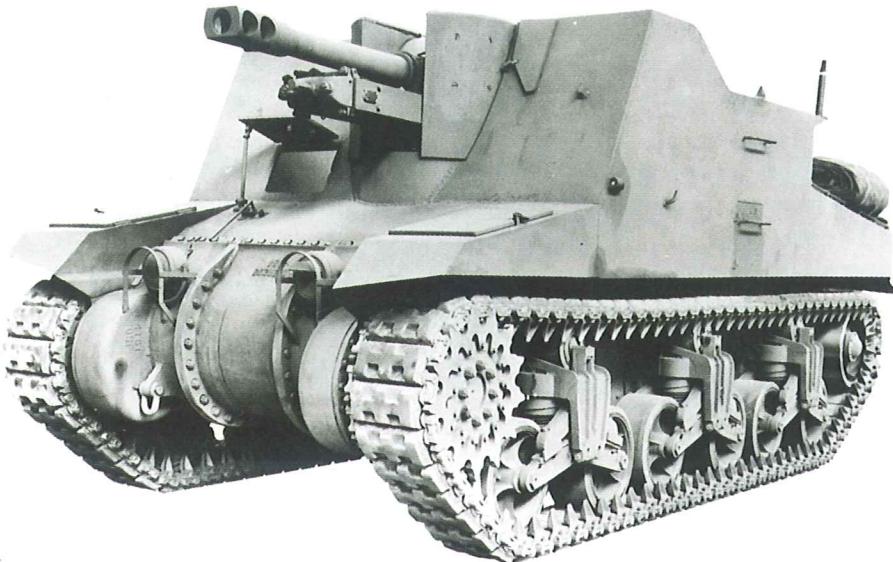
Weight (tonnes)	27.7	Front Armor (mm)	76
Length (m)	5.76	Side Armor (mm)	63
Width (m)	2.76	Engine HP	400
Height (m)	2.65	Road Speed (km/h)	42

Ram II tank (early model with side door)



Self-Propelled Gun, Sexton

This vehicle took the lower hull, including suspension, engine, transmission, etc., of the Ram II tank and fitted a new upper hull similar to that of the American M7 SP 105mm. The main weapon was the 25pdr gun-howitzer which had a traverse of 25° left and 15° right of center, an maximum elevation of 40° and a depression of -9°. Ammunition stowage was 87 rounds of HE and 18 of AP, a generous allowance supplemented by Ram Ammunition Carriers that often accompanied the vehicles. Two Bren guns were carried, but not mounted, for local defense. On some vehicles a .50cal MG on a pintle mount was added to the left front corner of the hull top. Highly successful, the Sexton became the standard SP artillery piece for both the British and Canadian Armies from 1944.

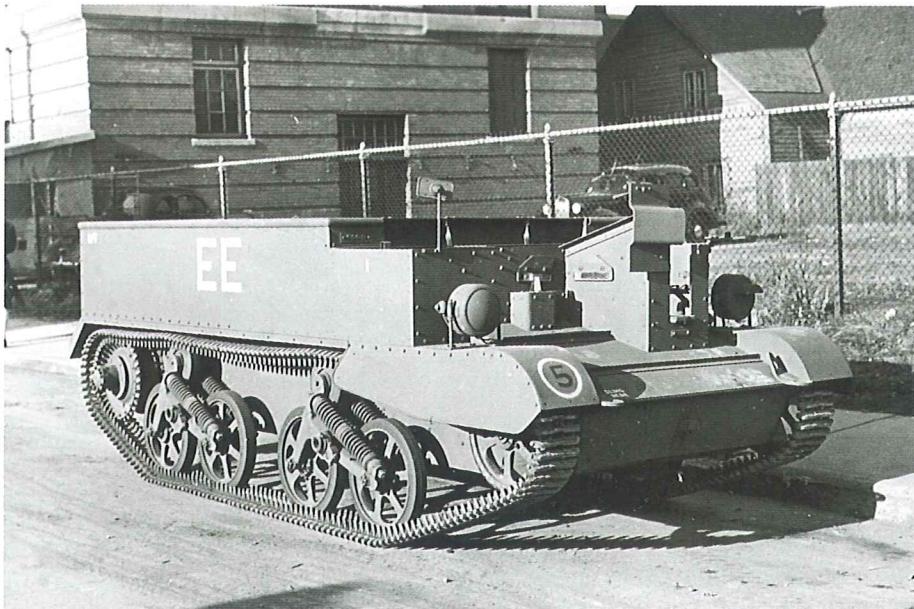


A Sexton self-propelled gun (PMK)

	Weight (tonnes)	22.7	Front Armor (mm)	50
	Length (m)	6.11	Side Armor (mm)	37
	Width (m)	2.74	Engine HP	400
	Height (m)	2.44	Road Speed (km/h)	42

Carrier, Windsor

The Windsor carrier followed from the American T.16 in being a lengthened version of the Universal Carrier. Both models added an extra road wheel on each side, resulting in a distinctive arrangement of two 2-wheel bogeys each side. This made both vehicles suitable for heavier duties, such as towing 6pdr AT guns. The Windsor had a crew of two and could carry three others, although more were often perched precariously on the vehicle in the field. The Canadian Army originally adopted the T.16 for this role, but switched to the indigenous Windsor when it became apparent that the latter had more usable cargo room. Being a cargo-carrier and prime mover the Windsor was unarmed, as was the T.16. The British ordered 5,000 Windsors, but production did not start until September 1944 and was terminated in April 1945, so they did not see service until near the end of the war.



Windsor Carrier

	Weight (tonnes)	4.86	Front Armor (mm)	12
	Length (m)	4.37	Side Armor (mm)	n/a
	Width (m)	2.11	Engine HP	95
	Height (m)	1.45	Road Speed (km/h)	55



Scout Car, Dingo

The Australian Dingo fitted an armored hull to the chassis of the Ford 15cwt truck, converted to 4x4 configuration. The crew sat side-by-side and consisted of two: a driver and a commander/gunner. The vehicle carried a Bren light MG which could be fired from a slot between the two visors in the front plate, from a high-angle mount at the rear, or dismounted. A No.19 radio was carried at the rear. A distinctive feature of the Dingo was the sloped rear plate, which reduced weight but also restricted what could be carried. The Dingo proved serviceable, but not outstanding. It was somewhat overloaded and the front axle was prone to bending. A program to lighten the vehicle by removing the roof and reducing armor thickness to 10mm all round was launched, but never went past the prototype phase.

Dingo Scout Car (PMK)



	Weight (tonnes)	4.5	Front Armor (mm)	30
	Length (m)	4.57	Side Armor (mm)	10
	Width (m)	2.08	Engine HP	85
	Height (m)	1.85	Road Speed (km/h)	80

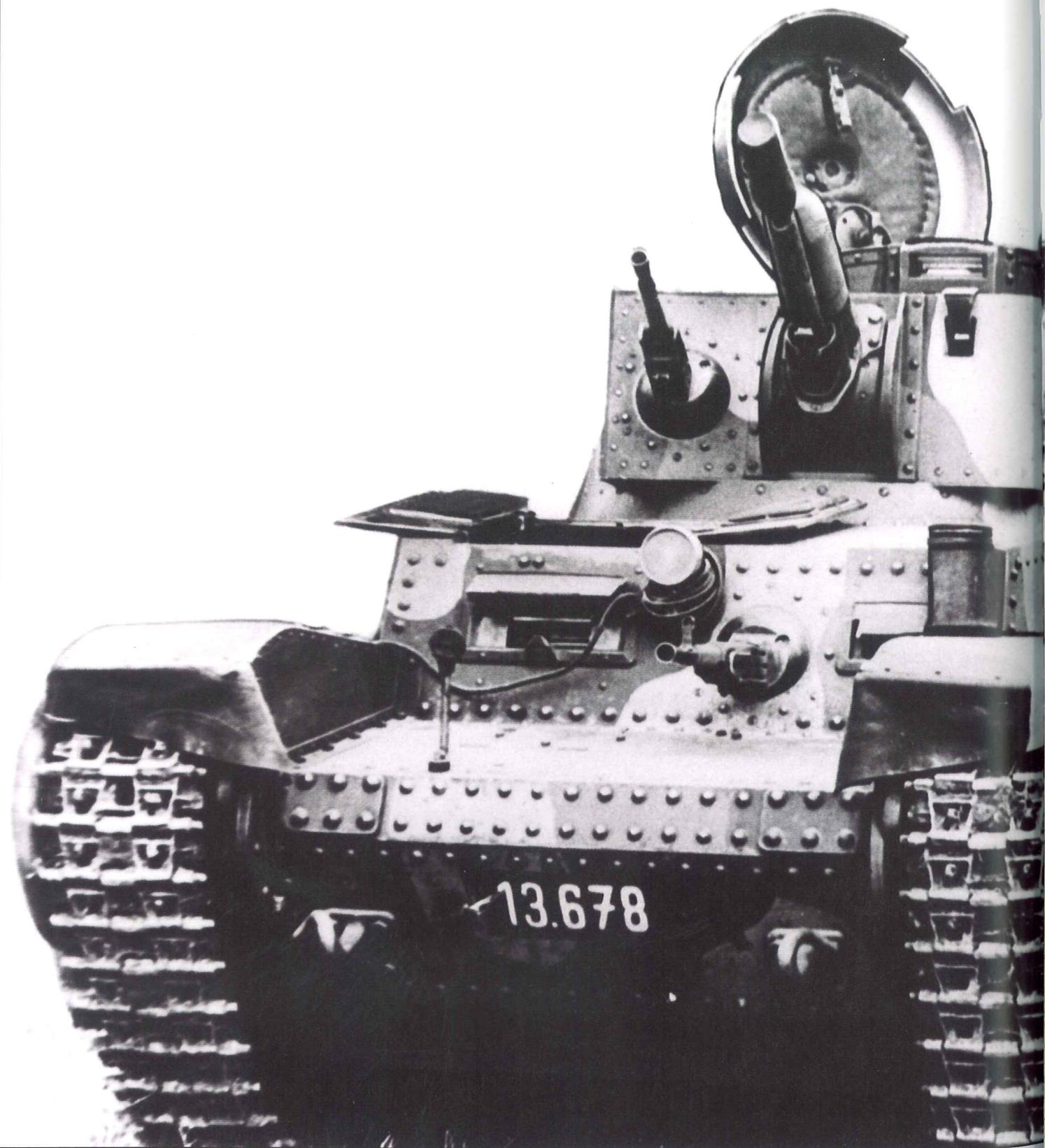
Wheeled Carrier India Pattern

This was a Ford 4x4 rear-engine chassis fitted with an armored body by Tata Ironworks. It held a crew of three and was normally armed with a Bren gun and an AT rifle. The basic version was the Mk II, followed by the Mk IIA with slightly larger tyres, then the IIB with a small extension of the hinged roof plate, and then the Mk IIC, which was slightly wider and had a stronger suspension. The IIC was the most widely produced and was built in three variants: 2,000 basic carriers, 211 3" mortar carriers, and 345 artillery observation vehicles, the latter with a small turret. The follow-on vehicle, the Mk III, was actually a light armored car, adding a fixed roof and a turret with a Bren gun and an ATR. The carriers were used in the same way the British units used Universal Carriers, as weapons carriers, reconnaissance vehicles, etc.



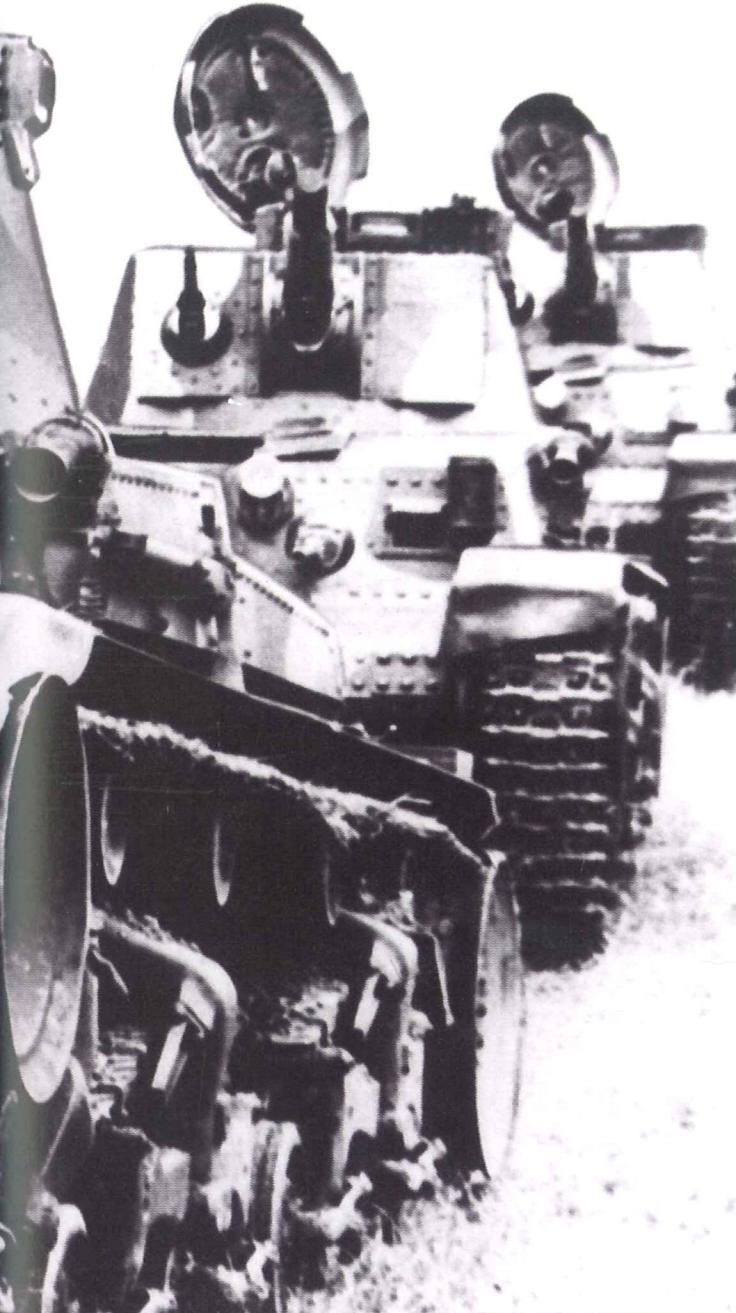
	Weight (tonnes)	5.2	Front Armor (mm)	n/a
	Length (m)	4.72	Side Armor (mm)	n/a
	Width (m)	2.29	Engine HP	95
	Height (m)	1.98	Road Speed (km/h)	83

A wheeled carrier Mk IIC in the desert





Czechoslovakia



The new Czechoslovak state began its existence with only a few old Lancia armored cars, although it inherited an impressive defense industry. In 1919 Skoda was directed to build armored bodies for 12 Fiat truck chassis, an unsuccessful first attempt at indigenous AFV procurement. The vehicles were scrapped in the late 1920s.

Starting again from scratch, Skoda developed the PA-I armored car with a purpose-built 4x4 chassis with four-wheel steering and delivered two prototypes in 1923. Later that year the army ordered a dozen PA-II armored cars, popularly known as "turtles". Their advanced chassis and rounded hulls were well in advance of their time, but their lack of turrets limited their military usefulness. They were sold to various police units in the 1930s.

The successor was the PA-III, which used flat plates instead of a rounded unitary body to reduce costs and installed a turret with a Schwartzlose machine gun. Nevertheless, the complex chassis ensured that the car remained expensive, and the Army was only able to purchase 15. They served until the annexation of the Czech regions, when three went to Slovakia, three to Romania and the rest to Germany where they were scrapped.

The last attempt at armored car development was driven by the need to reduce the price of the expensive Skoda models. Tatra developed an armored body for their 6x4 Model 26/30 truck and 51 were ordered in 1930 as the OA vz.30. This followed the standard practice of the day in being essentially an armored truck with a turret on the rear compartment. The turret mounted a 7.92mm ZB26 light machine gun, and a second such weapon was fitted in a ball mount in the front next to the driver. Cross-country performance was good for a vehicle of its type but the 3-6mm armor was thin and the armament quite weak. They served until the German takeover, with 18 going to the Slovaks and 9 to the Romanians. These were to be the last armored cars built in Czechoslovakia, attention having turned to tanks.

Having no experience in building tanks it seemed logical to start with modest vehicles. By the late 1920s CKD had emerged as a competitor to Skoda. In 1930 they persuaded the Army to buy four Mk VI machine gun carriers and a trailer from Vickers and acquired a production license. After building 4 straight copies, CKD improved the vehicle and in April 1933 the Army placed an order for 70 vehicles, to be known as the vz.33 tank, these being delivered in 1934. These were similar to the Polish TK versions of the

vehicle, with a superstructure extended upwards to provide full (if thin) protection for the 2-man crew. The main difference was the addition of a second ZB26 light machine gun alongside the driver, fired by a bowden cable.

In the meantime, rival Skoda had not been idle. They developed a series of tankettes, also based on the VCL concept, although they were unable to win any army contracts. Their only success, and a very modest one, came with a development that squeezed the 3.7cm Skoda A3 tank gun into the front. Retaining the two-man crew of the tankette genre it was not terribly practical, but eight were sold to Yugoslavia in 1937.

Even as CKD was working on the original Vickers tankettes, they recognized the need for a true tank. Thus, by November 1932, the Army had accepted for test a light tank from the firm designated the P-II. The tank was conventional in appearance, if somewhat small, and featured a driver and a radio operator in the hull front, behind which sat a one-man turret for the commander/gunner. The turret mounted a 3.7cm tank gun and a coaxial machine gun. With only 15mm maximum armor, the tank was quickly obsolete, but it was a beginning and the Army ordered 50 vehicles (6 pre-series and 44 production) in 1933 as the LT (light tank) vz.34. The tanks were delivered in 1934-35. Attempts to sell them off were ended by the German annexation and 27 found their way to Slovakia (where they were used as training vehicles) and the remainder went to the Germans, who scrapped them.

The LT vz.34 had been developed purely as a private venture by CKD and its appearance prompted the Army staff to begin drafting official requirements documents that would guide future procurement. The result was a rather confusing set of specifications for three variants each of two main types of tank, light and medium. During 1934-37 the Army's budget contained funding for 279 light and 42 medium tanks.

Stung by CKD's successes in the tank field, Skoda launched a two-prong effort to gain entry. On the one hand, they began development of a light tank, the S-II-a to compete with the equivalent P-II-a from CKD, and on the other they concluded an agreement with CKD that no matter who won the light

tank competition, they would share production between them.

Trials in the summer of 1935 led to the acceptance of the Skoda S-II-a as the new light tank with the designation LT vz.35. The first 160 were ordered in October 1935, followed by 12 more in May 1936, and 106 more in June. Skoda delivered its half of the vehicles between December 1936 and April 1938. CKD delivered all of theirs in 1937.

For the medium tank role Skoda submitted its S-II-c, a larger version of the S-II-a (LT-35), while CKD proposed its V-8-H. The CKD vehicle won, based on its slightly greater maturity, and an initial contract was signed but then cancelled following the Munich agreement.

These selections had not ended, or even slowed, tank development efforts at the two firms. For one thing, it was clear even the expanding Czechoslovak Army could not absorb all the tanks that the two firms could produce, thus pushing them towards exports. For another, the complexity and shortcomings of the LT-35 light tank were become apparent and a replacement would soon be needed.

With great prescience, CKD switched from the bogied small road wheels that formed the suspension of their earlier vehicles to a Christie-type suspension, but using layers of leaf springs, for their new generation. The first vehicle to see service using this new system was also the

smallest, representing a complete rework of the tankette concept. The AH-IV tankette was built in Iranian and Romanian configurations for export, and then redesigned to meet Swedish requirements.

The same efficient suspension, scaled up, was used on CKD's planned successor to the LT-35, the TNH series. The result was one of the best all-round tanks of its time, and one whose automotive system was highly regarded to the end of the war. The vehicle met with immediate export success, first to Iran, then to Peru, Switzerland and Latvia. In October 1937 the Ministry of Defense laid out a requirement for a new light tank. After a competition in early 1938 between various CKD and Skoda models the CKD TNHPS was chosen as the clear winner and in April an order was placed for 150 tanks.

Events were quickly to render this academic, however. In September 1938 the Munich agreement forced Czechoslovakia to turn over the Sudetenlands to Germany and most defense contracts were cancelled. At the end of 1938 the Army held 15 vz.27 and 51 vz.30 armored cars, 70 vz.33 tankettes, and 51 vz.34 and 298 vz.35 light tanks, along with various prototypes. In March 1939 the Slovak portion formally seceded and Germany occupied the Czech region as the "Protectorate of Bohemia-Moravia". Czechoslovakia ceased to exist.

Type	Mfg	Customer	1933	1934	1935	1936	1937	1938	1939
Armored Cars									
OA vz.30	Tatra	Czechoslovakia	-	51	-	-	-	-	-
Tankettes									
vz.33	CKD	Czechoslovakia	-	70	-	-	-	-	-
S-I-d (T-32)	Skoda	Yugoslavia	-	-	-	-	8	-	-
AH-IV	CKD	Iran	-	-	-	50	-	-	-
AH-IV R	CKD	Romania	-	-	-	-	-	35	-
AV-IV Sv	CKD	Sweden	-	-	-	-	-	48	-
Light Tanks									
LT vz.34	CKD	Czechoslovakia	-	-	20	30	-	-	-
LT vz.35	Skoda	Czechoslovakia	-	-	-	15	113	-	-
	CKD	Czechoslovakia	-	-	-	-	149	-	-
R-2	Skoda	Romania	-	-	-	-	15	61	50
TNH	CKD	Iran	-	-	-	40	10	-	-
LTP	CKD	Peru	-	-	-	-	-	7	17
LTH	CKD	Switzerland	-	-	-	-	-	-	24

Pre-Annexation AFV Production



The Protectorate

The bulk of the Czechoslovak armored vehicle park was confiscated by the Germans, including 9 OA vz.27 and 24 OZ vz.30 armored cars, 40 vz.33 tankettes and 23 LT vz.34 light tanks, all of which were scrapped fairly quickly, and 244 LT vz.35 light tanks, which they took into their inventory after some modifications as the PzKw 35(t).

Of more significance was that BMM (the former CKD) was turning out LT-38 tanks on the initial order for 150. These the Germans eagerly took over, receiving 78 by the outbreak of the war in September 1939. The Germans renamed the tanks the PzKw 38(t) [t = tschech], with the original series becoming the Ausf (model) A. Following their good performance in the Polish campaign, orders were placed for 110 each of models B and C and 105 model D, differing in detail. The models E and F were similar, but the frontal armor, hull and turret, was increased to 50mm. The 90 Model S tanks had been ordered by Sweden and were similar to E/F, but were confiscated by the Wehrmacht on completion. The final version was the model G, designed to simplify production.

By early 1942 the PzKw 38(t) was clearly obsolete, especially on the eastern front. The 37mm gun and 2-man turret represented an anachronism that could not be remedied due to the small size of the hull. On the other hand, the automotive performance of the tank was excellent. In addition, production capacity had already been built up, so the clear preference would be to find other uses for the chassis.

The same problem was becoming apparent with the PzKw II light tank and a common solution was adopted. The simplest expedient was to eliminate the turret from the PzKw 38(t) and replace it with a heavy anti-tank gun on a mount, surrounded on three sides by a thin armored shield. This yielded the Marder vehicle, armed with the captured Soviet 7.62cm Pak36(r) rechambered for German cartridges or the 7.5cm Pak40. Deliveries of the Russian-armed vehicle began in April 1942, and of the 7.5cm vehicle in November. The last 194 of the PzKw 38(t) model G tanks were diverted to Marder production, and the following Model H was given over entirely to SP guns. A similar vehicle to the early Marders was the 15cm sIG "Grille". In this case the main gun was the 15cm

	1939	1940	1941	1942	1943	1944	1945
Production							
PzKw 38(t) Ausf A	150	-	-	-	-	-	-
PzKw 38(t) Ausf B-D	3	322	-	-	-	-	-
PzKw 38(t) Ausf E, F & S	-	45	570	-	-	-	-
PzKw 38(t) Ausf G	-	108	198	-	-	-	-
SdKfz 138 Marder Ausf H	-	-	110	150	-	-	-
SdKfz 138 Marder Ausf M	-	-	-	633	323	-	-
SdKfz 139 Marder Ausf G & H	-	-	344	-	-	-	-
SdKfz 138/1 sIG 33 Ausf H & K	-	-	-	201	-	-	-
SdKfz 138/1 sIG 33 Ausf M	-	-	-	14	192	-	-
SdKfz 138/1 munition	-	-	-	10	154	-	-
SdKfz 140 FlakPz	-	-	-	101	40	-	-
SdKfz 140/1 AufklPz	-	-	-	-	70	-	-
JgPz 38(t) Hetzer	-	-	-	-	-	1,687	1,335
Conversions							
SdKfz 138 Marder Ausf A-G	-	-	-	-	336	-	-
SdKfz 139 Marder Ausf A-G	-	-	-	-	39	-	-

Deliveries by BMM 1939-45

infantry howitzer, and the side armor was extended further to the rear.

Simply bolting the piece over the turret opening was a simple change for the factory and the configuration was amenable to retrofit of vehicles being returned for overhaul, but yielded a tall, ungainly vehicle. In late 1942 an effort was made to modify the chassis and hull to optimize it for the weapons-carrier role. The result was the Model M chassis, in which the engine was moved to the center of the vehicle, the radio-operator's position in the hull front deleted to make room, and a flat bed placed at the rear, along with a range of detail changes to improve performance.

An order for a thousand Model M chassis was placed in early 1943, of which 568 were given over to SdKfz 138 Marders, 221 to SdKfz 138/1 Grilles (including 103 as ammunition carriers), 141 as SdKfz 140 FlakPanzers, and 70 as SdKfz 140/1 reconnaissance tanks. The last-mentioned were unusual, for they retained the old configuration of engine in the rear and two men in the hull front, and were thus Model Ms only in the sense of incorporating the automotive component changes of that version. A further 74 Model Ms were subsequently ordered, these for Grille gun vehicles.

The reign of the Model M chassis was to be short, however. The assault gun configuration had proven much superior to the tall open-topped vehicles based on the Model M and air

raid damage to the Alkett factory caused the German high command to investigate producing the StuG III at BMM. The Czech firm could not handle 24-ton vehicles, so as an alternative, they were directed to come up with a design for a light tank hunter. By January 1944 a wooden mock-up was ready, using many of the components of various models of the PzKw 38(t). The result was the JagdPanzer 38(t), unofficially the "Hetzer". Given the constraints of needing a powerful gun while not exceeding the approximate 16-ton weight limit imposed by factory machinery, the result was outstanding. The first Hetzers came off the line in April 1944. Thereafter BMM finished existing orders for earlier vehicles but no new ones were placed. Production of the M-series steadily decreased and the last nine vehicles came off the line in September 1944. Production then concentrated exclusively on the Hetzer.

While the selection of the TNH series by the Germans in 1939 for continued production as the PzKw 38(t) kept the CKD/BMM factory busy with armored vehicle orders, the same was not true for Skoda. They had ten T-11 tanks (close relatives of the LT-35) in production for Afghanistan in 1940 and these were finally sold to Bulgaria. They also further developed their original proposal for the Czechoslovak medium tank competition, the S-II-c, into the T-21. The prototype was sent to Hungary for trials in June

1940 and in August a license production agreement was signed allowing Hungary to produce the tank as the Turan I. Thereafter, Skoda concentrated almost exclusively on guns and repair of tanks. A few projects were developed to the prototype stage, but no production ensued.

Slovakia

When it declared its independence in March 1939 the Slovak state inherited 3 OA vz.27 and 18 OA vz.30 armored cars, 30 vz.33 tankettes, and 27 vz.34 and 52 vz.35 light tanks. Of these, only the LT-35s could be considered operationally useful vehicles and the Slovak Army requested Skoda to build more for it, but the tank was out of production by that time.

Instead they ordered ten LT-38 tanks from BMM in April 1940, these being in production for Germany as the PzKw 38(t). In August they purchased 21 LT-40s, these being LT-38s slightly modified for the original customer, Lithuania, and stuck in the CKD warehouses after the Soviet takeover of that country. An additional 20 LT-38s were ordered in September 1940. Because German orders took precedence at the BMM works, it was June of 1942 before the last of these was delivered. An order for an additional seven LT-38s was placed in early 1941, and these were delivered in October 1942.

In June 1943 the Army purchased 58 more LT-38s, this time from German Army depots, and of all models A through H and S. Only 37 were actually delivered, in batches of 20 in

August 1943, 12 in December 1943, and five in July 1944. This was the last purchase of these vehicles, as they were now obsolete.

In early 1943 the Army approached Germany for the sale of long-barrel PzKw IV tanks, but the Germans agreed to sell only 5 PzKw IIIN with the short 75mm for training, these being delivered in March 1943. Shortly after that an order was placed for 20 PzKw II light tanks to be used for reconnaissance, although only 16 were actually delivered, January 1944. Finally, in early 1944 the Army ordered 26 Marder model H anti-tank vehicles from BMM, but once again delivery was never completed, only 18 being delivered, in mid-1944. This was the last of the armored vehicles to be delivered to the Slovak Army.

Tankette AH-IV

There were two variants of this tank, Iranian and Romanian, differing only in detail. The driver sat at the right front and off to his right had a 7.92mm light MG with limited traverse in a ball mount that he could fire if he found the time. The small one-man turret was mounted to the left and carried a 7.92mm ZB35 air-cooled heavy-barrel machine gun. The excellent suspension, predecessor of that made famous by the LT-38, consisted of four large road wheels with leaf-spring suspension. These gave the AH-IV very good cross-country mobility. A modified design was purchased by Sweden (q.v.). Despite their admirable agility, the day of the MG-armed tankette had clearly passed, and the lack of a radio and 2-man crew limited their usefulness as scout vehicles.



	Weight (tonnes)	3.50	Front Armor (mm)	12
	Length (m)	3.20	Side Armor (mm)	n/a
	Width (m)	1.79	Engine HP	55
	Height (m)	1.69	Road Speed (km/h)	45

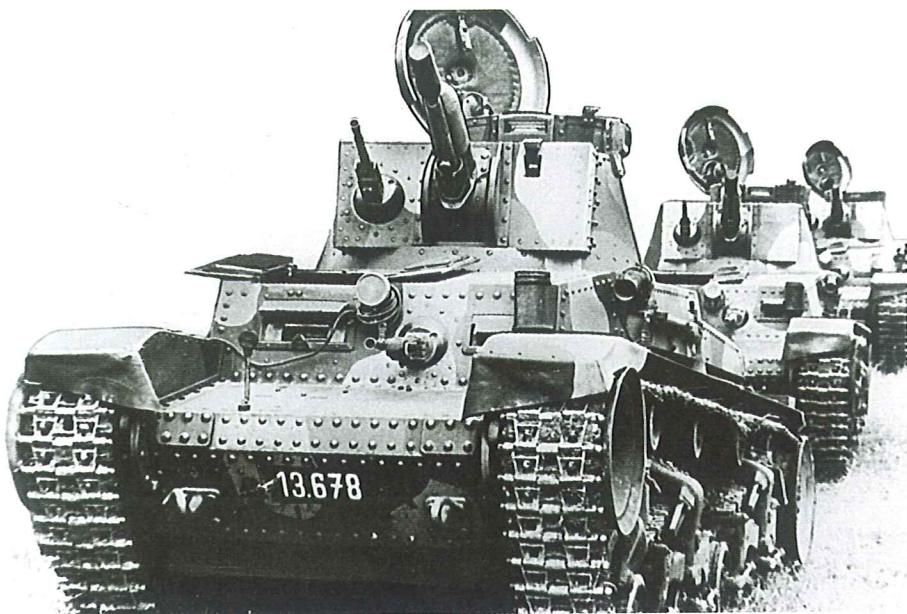
An AH-IV in Romanian service (PMK)



Light Tank LT-35 (German Pzkw 35(t))

Of conventional layout, the Skoda LT-35 was crewed by a driver and a radio operator/machine gunner in the front, and commander/gunner in the turret. The turret mounted a 3.7cm vz.34 gun (for which 78 rounds were carried) and a coaxial 7.9mm vz.37 machine gun. The turret was manually rotated, with a free-rotation disconnect lever for rapid traverse. The tank featured pneumatically-assisted steering and shifting that made the driver's job easier, but added to the maintenance burden. The tank had a telegraphic radio and no intercom, but when the Germans took them over they replaced the radio with a voice set and added an intercom. The Germans also found room to add a fourth crew member to the turret, who acted as a loader. The LT-35 was a good, if complex, tank for its time, with a powerful gun and adequate armor.

LT-35s with turret hatches open (PMK)

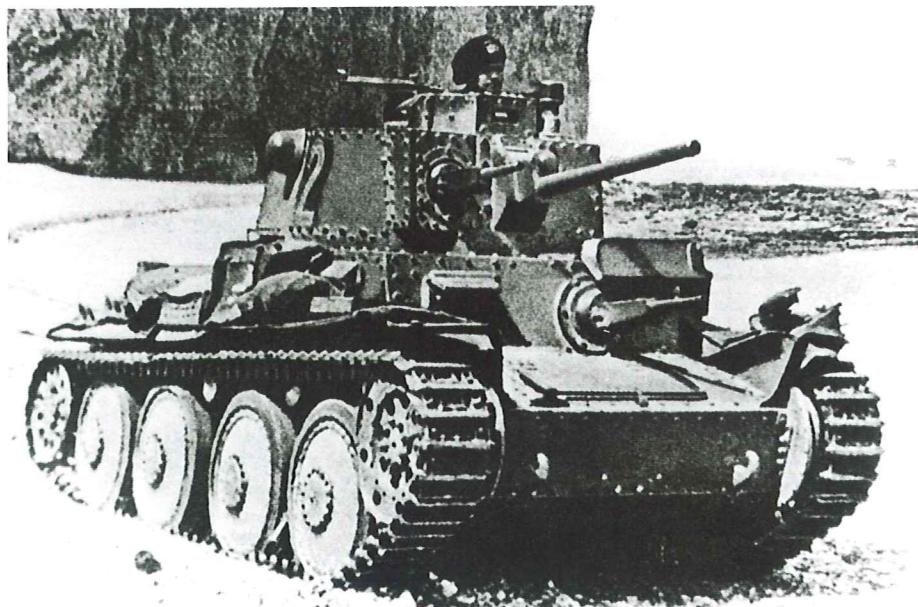


	Weight (tonnes)	10.5	Front Armor (mm)	25
	Length (m)	4.90	Side Armor (mm)	15
	Width (m)	2.06	Engine HP	120
	Height (m)	2.37	Road Speed (km/h)	34

Light Tank LT-38 (TNH series) (German PzKw 38(t))

Although differing in detail, the various members of the family were generally similar. The four-man crew consisted of a driver and a radio operator in the front, with a ball-mounted MG between them, and the commander and gunner in the turret. Turret armament in the LT-38 consisted of the 3.7cm A7 gun (with 90 rounds) with a second MG in a ball-mount parallel to the main gun. The Germans replaced the telegraphic radio with a voice unit and added an intercom. By the standards of 1939/40 it was a remarkably well-balanced tank design. However, the tank's automotive excellence was somewhat offset by its lack of growth potential due to the narrow hull. It could not be upgunned, nor could a third turret crewman be added. Models E and onwards of the German series had frontal armor increased to 50mm.

PzKw 38(t)

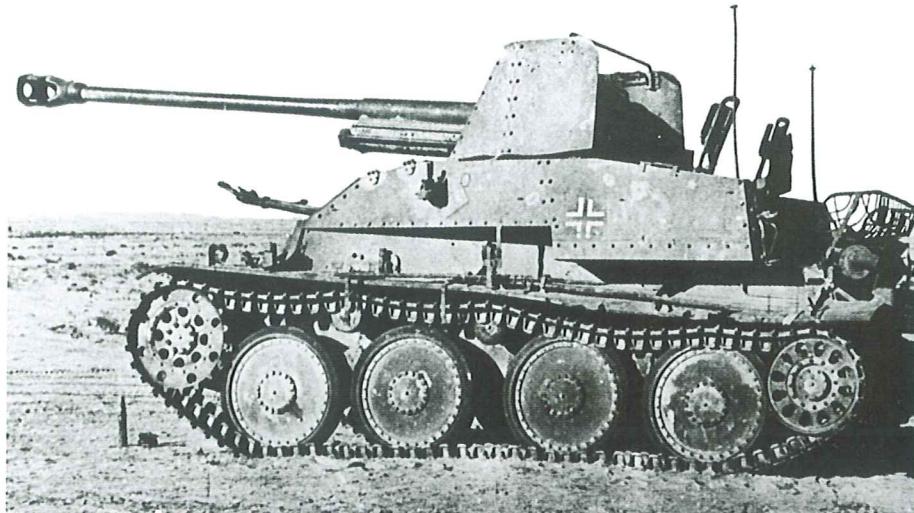


	Weight (tonnes)	9.5	Front Armor (mm)	25
	Length (m)	4.61	Side Armor (mm)	15
	Width (m)	2.14	Engine HP	126
	Height (m)	2.40	Road Speed (km/h)	42

PzJag 38(t) (SdKfz 138/139) (Marder)

This was a simple change to the PzKw 38(t), involving mainly the elimination of the turret in favor of a three-sided shield around a large anti-tank gun. In the SdKfz 139 this was the 7.62cm Pak36(r), and in the SdKfz 138 it was the 7.5cm Pak40/3. 194 of the SdKfz 139s were built on the Model G chassis, the rest of the 139s and 275 of the SdKfz 138s were built on the Model H chassis with a more powerful engine. The SdKfz 138 Model M was more refined, with the engine moved to the center, leaving a gun deck at the rear. This lowered the silhouette and improved ergonomics. The hull machine gun, found in earlier models, was deleted in the 138M. Main gun traverse was 21° each side in the 138M and 139, and 30° in the 138H. Ammunition stowage ranged from 27 to 38 rounds.

SdKfz 139 Marder on Model G chassis (PMK)

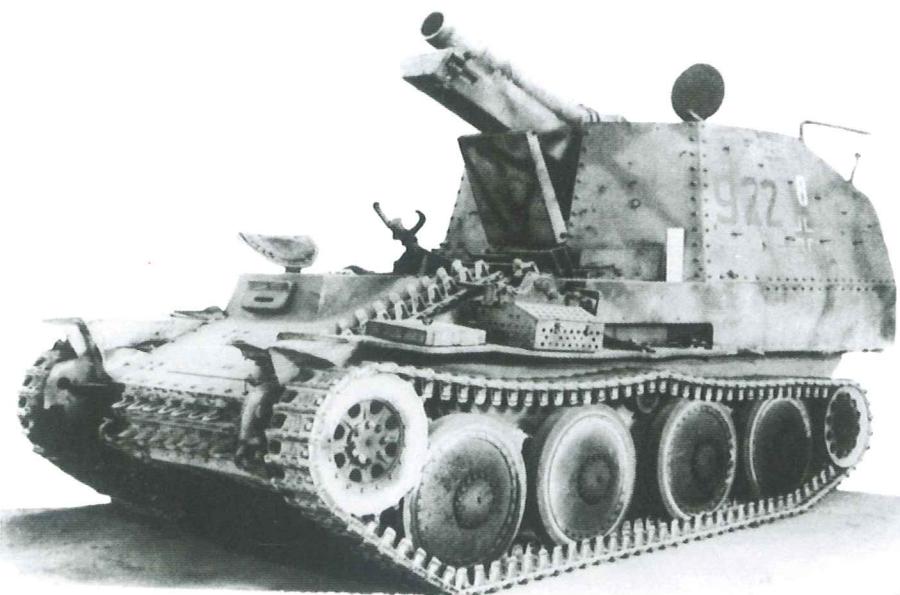


First column Model H,			Height (m)	2.51	2.48
Second column Model M			Front Armor (mm)	50	15
Weight (tonnes)	10.8	10.5	Side Armor (mm)	15	15
Length (m)	5.77	4.95	Engine HP	150	150
Width (m)	2.16	2.15	Road Speed (km/h)	47	47

SdKfz 138/1 (Grille)

This was essentially the Marder configuration but with a 15cm heavy infantry gun replacing the anti-tank gun. The first series, on the model H and K chassis, were analogous to the Model H Marders but with the side shields extended further to the rear to accommodate the large ammunition and the bow MG removed, although a light MG was carried loose. Ammunition stowage was 15 rounds of main gun ammunition. Later models, based on the Model M chassis, had the engine in the center and the gun position at the rear, where 18 rounds were carried. In both cases traverse was 5° each side. The 15cm infantry gun was a fearsome support weapon, and in that role the Grille was successful. The armor was too thin for an effective assault gun, however, and the small size limited ammunition stowage to an extent that variants had to be built as ammunition vehicles to carry 40 rounds.

SdKfz 138/1 Grille SP 15cm on Model M chassis



Weight (tonnes)	10.8	Front Armor (mm)	15
Length (m)	4.84	Side Armor (mm)	15
Width (m)	2.26	Engine HP	150
Height (m)	2.15	Road Speed (km/h)	47



FlakPanzer 38(t) (SdKfz 140)

This vehicle took the Model M chassis, with the engine in the middle, and placed a single 2cm Flak38 automatic cannon in the rear bed. The superstructure was built up on all four sides and the upper portion folded down to facilitate full traverse at low angles of elevation. Ammunition carriage was 1,040 rounds. No secondary armament was fitted or carried. The crew consisted of the driver in the front and a gun detachment of 3 or 4 in the rear. Intended solely as a stop-gap measure, the armament proved so weak that the Flakpanzer 38(t) itself often became the target of Allied fighter-bombers, while its armor was too thin to prevent strafing damage by heavy aircraft machine guns.



SdKfz 140 FlakPanzer 38(t) (PMK)



Weight (tonnes)	9.7	Front Armor (mm)	50
Length (m)	4.61	Side Armor (mm)	15
Width (m)	2.15	Engine HP	150
Height (m)	2.25	Road Speed (km/h)	48

JagdPz 38(t) Hetzer

This vehicle shared the automotive components of the PzKw 38(t) family, but had a wider hull, needed in order to allow traverse of the main gun. Even so, traverse was limited to 5° left and 10° right of center. The main gun was the 7.5cm Pak39 L/48, for which 41 rounds were carried. A remote-control machine gun was mounted on the roof, with a 50-round magazine, and was aimed and fired by the loader via periscope. The driver sat at the left front, the gunner behind him (aiming via a periscope), the loader behind him, and the commander on the right behind the gun. The Hetzer was a remarkable design, combining small size, well thought-out armor protection and a lethal gun. It was also very cramped inside, had poor visibility of the outside, and the limited traverse of the main gun, especially to the left, could create tactical problems.



Weight (tonnes)	15.75	Front Armor (mm)	60
Length (m)	6.38	Side Armor (mm)	20
Width (m)	2.63	Engine HP	160
Height (m)	2.17	Road Speed (km/h)	43

JagdPanzer 38(t) Hetzer





France

The French Army, like many others, distinguished between armored vehicles for the infantry and those for the cavalry. Although the two grew together so that there was substantial overlap between the two types by the time the war broke out, the specifications were usually drafted separately and thus the distinction is a convenient one for analysis.

France was one of very few countries to have significant competition in both the design and production of tanks during the inter-war years. Although Renault dominated the field in the 1920s, due largely to its success with the wartime FT tank, other firms began joining the fray in the early 1930s and by the middle of the decade FCM, Somua and Hotchkiss were all competing with each other and Renault for their share of the rearmament market.

Infantry Vehicles

The end of World War One saw the French Army both blessed and burdened by huge quantities of the best tank of the war, the Renault FT. As a result there was little impetus for modernizing the tank park. The 1926 armament program did establish broad categories for new tanks, dividing them up into three groups. The light tank was to weigh less than 13 tons, be of simple construction and easy to operate, and have a 2-3 man crew. The battle tank was to weigh 19 to 22 tons and was to take on heavier resistance and was to be armed with a high-velocity gun or a 75mm short-barrel gun. The heavy tank was to weigh up to 70 tons.

Renault continued developing its FT tank through the 1920s, resulting in the Renault NC in 1927, but the improvements over the FT were insufficient for the French Army to buy any. A small number were sold for export, but mostly for trials with no real orders following. Further development of the NC yielded the char D, which appeared in prototype form in 1929, with an order for a first 15 following that December.

The heavy tank category was to prove a dead end. Although ten of the giant Char 2C were built in 1921, they quickly proved to have limited utility and further development was halted.

In 1933 three classes of infantry tanks were defined: the light tank was to be proof against light anti-tank weapons, the medium tank against heavy anti-tank weapons, and a heavy tank, with the last-mentioned being essentially dormant.

Several firms vied for the light tank award, the most famous being



Left: A Char B-1 on maneuvers, 1938.

Renault, Hotchkiss and FCM. The futility of trying to accomplish anything on the original weight limit of 6 tons quickly became apparent, and in fact the vehicles put forward weighed almost 11 tons. Even within that weight, however, the relatively heavy armor required severely constrained the size of the tanks, resulting in small, two-man designs suitable for the role of supporting infantry in WW I-style battles but little else. The winner was from Renault and an initial order was placed in July 1935 under the designation R-35. A massive production program was launched that would make it the most numerous post-WW I tank in the French inventory in 1940. Nevertheless, one shortcoming of the R-35, its short range, was recognized. The FCM entrant in the competition had used a diesel engine that gave a range of 225 km, as compared to 130 km for the Renault version, and a year later two battalions worth of FCM tanks were also ordered.

As rearmament began the infantry branch began looking for additional quantities of tanks. Renault was expanding, but for the time being was fully booked. Hotchkiss, on the other hand, had excess capacity and this, combined with the fact that the Hotchkiss was a simpler tank than the R-35 (and thus presumably cheaper), led the infantry to order the H-35 as well, starting in mid-1937.

For the medium tank role the infantry had three battalions of D-1 tanks under order by

1933. A heavier vehicle had begun development in 1927 with a 75mm gun mounted in the hull and twin machine guns in a turret. Three prototypes were produced in 1930 and trialled in 1931 as the Char B1. Further work increased the armor thickness and replaced the original turret with a new model with a 47mm gun and coaxial MG. A small number were ordered in 1934 before further development yielded the definitive B-1bis, which became the main production variant. For its intended role of infantry support the B-1bis was an impressive piece of equipment. Its frontal armor was impervious to all German AT weapons of the time except

when the 88mm Flak was pressed into anti-tank duties, and the 75mm howitzer threw a very useful HE round, while the 47mm SA35 gun was lethal against enemy tanks. When used in other than its strictly-defined intended role, however, its shortcomings became painfully obvious. The rate of engagement was slow for both main weapons, the 75mm because the whole tank had to be turned to aim the gun, and the 47mm because there was only one man in turret who had to acquire the target, aim and fire the gun, and reload it. The vehicle's range was satisfactory, the equivalent of the German PzKw III, but its speed was slow, limited the engine and transmission on the road and by the archaic suspension cross-country. An improved model, known as the B-1ter, which incorporated thicker armor and 10° of traverse for the howitzer, was built to prototype stage but no production ensued, as efforts were concentrated on the need to build existing models.

One of the painful lessons learned during the First World War was the difficulty of supplying advancing troops in dense trench warfare. To remedy this Renault developed a small, lightly armored resupply tractor known as the UE, which featured a cargo bed in the rear and a tracked trailer. A first series of 60 was built in



Right: The Renault R-35 was the most numerous of the modern tanks.



Date	Type	Qty	Delivery
Dec-30	D-1	70	January to November 1932
Jul-32	D-1	30	June to August 1933
Oct-33	D-1	50	January to December 1935
Mar-34	B1	7	December 1935 to May 1936
Dec-34	B1	20	March 1936 to January 1937
Dec-34	D-2	50	April 1936 to February 1937
Jul-35	R-35	300	March 1936 to September 1936
Jun-36	FCM	100	May 1938 to March 1939
Sep-36	R-35	200	December 1936 to August 1937
Sep-36	R-35	95	July 1937 to June 1938
Feb-37	R-35	205	March 1938 to September 1939
May-37	B1bis	35	April 1938 to March 1939
Jun-37	H-35	200	March to June 1939
Jul-37	H-35	100	December 1937 to March 1939
Oct-37	B1	5	June to July 1937
Oct-37	B1bis	35	April 1937 to March 1938
Feb-38	B1bis	90	January 1939 to October 1939
May-38	R-35	500	February 1939 to January 1940
Jun-38	D-2	50	February to June 1940
Jul-38	H-35	72	August 1939 to February 1940
Sep-38	R-35	110	January 1940 to May 1940
Sep-38	R-35	50	February 1940 to June 1940*
Oct-38	R-35	100	January 1940 to June 1940*
Dec-38	R-35	20	February 1940 to June 1940*
Dec-38	R-35	20	February 1940 to June 1940*
Jan-39	H-35	130	February to April 1940
Mar-39	B1bis	35	October 1939 to January 1940
Apr-39	H-35	200	January to May 1940*
Sep-39	B1bis	104	January 1940 to May 1940
Sep-39	B1bis	63	May 1940 to June 1940
Mar-40	R-35	300	March 1940 to June 1940*

* deliveries not completed

Pre-War Infantry Tank Orders

1932 and by the end of 1935 some 793 had been ordered and almost all delivered. In 1936 the Issy-les-Moulineaux facility of Renault was nationalized into AMX, and with it the UE production line. Demand for these vehicles was so great that two more factories were brought into the production scheme, Berliet at Lyon and Fouga at Béziers. Eventually, Renault/AMX built 2,200 UE, Berliet 100 and Fouga 300. The improved UE2 version was introduced into all three factories and by April 1940 AMX had built 1,080 of these, Berliet 310 and Fouga 260, making the UE family by far the most common French armored vehicle of the 1940 campaign. Built in large numbers, the UEs were assigned to the infantry regiments as armored resupply vehicles and to tow the 25mm anti-tank guns. The idea was a worthy one, but the UE had a

very limited cargo capacity and inevitably, as a tracked vehicle, imposed additional maintenance and logistical burdens on the infantry regiment.

To resupply the infantry tank formations, which were to accompany the infantry in their advance, something larger would be needed. The solution to this problem was the development by the Lorraine firm of a larger resupply tractor. Their CRI tractor had initially been developed as a potential replacement for the little UE, but the UE2 had been chosen instead. Lorraine responded by lengthening the chassis and adding a third two-wheel bogey to each side to yield the Tracteur de Revitaillement pour Chars (TRC) which had a larger cargo capacity and normally towed a special tracked fuel trailer. Three orders, totalling 278 vehicles,

were placed in 1938, followed by two more orders totalling 174 in 1939.

Cavalry Vehicles

The 1931 armament program provided for three types of armored vehicles for the cavalry. The Automitrailleuse de Découverte (AMD) was to be a high-speed vehicle with long endurance for distant reconnaissance, in practice an armored car. The Automitrailleuse de Reconnaissance (AMR) was to be a light, two-man vehicle for local reconnaissance. The Automitrailleuse de Combat (AMC) was to provide combat power for the cavalry and was, for all practical purposes, a tank.

The requirements envisioned a single model of AMD, but in fact there were two sets of requirements. The metropolitan army needed a modern, well-armed and fairly well protected vehicle. The vast French colonial possessions and protectorates in North Africa and the Middle East, however, would do better with a less sophisticated vehicle. The solution adopted was to start with modernization of existing vehicles and then develop an all new vehicle, the introduction of which would allow the older vehicles to "trickle down" into the colonies.

France had 200 old White Model 1917 armored cars left over from the First World War. Hopelessly outdated in terms of automotive performance, the hulls of 98 of these vehicles were lifted from their chassis in 1932-34 and placed on new Laffly LC2 chassis with 50 hp engines, to yield the White-Laffly or Laffly 50 armored car. A second lot of 28 vehicles was similarly transformed in 1934-35, but with an 80 hp engine and some modifications to their hull and armament by the Vincennes facility to yield the Laffly-Vincennes or Laffly 80 armored car. Panhard also built 28 4x4 armored cars known as the AMD 165/175 and 31 personnel carrier derivatives as the Model 179, while Laffly built 45 colonial armored cars of an entirely new design known as the S15 TOE. The 6x6 S15 TOE was a thoroughly modern vehicle with great mobility, long range and armed with a turret with a single 7.5mm machine gun, all that was really required. It also had an open bed in the back for cargo or four scouts.

Unfortunately, it was also far too complex for colonial operations and proved mechanically unreliable. All these vehicles, except a single



Left: Two H-35 light tanks after the fighting in June, 1940.

vehicles. These vehicles were inherited by the new AMC category in 1931, although they were really no better armed or protected than the AMDs of the time. Once again, Renault launched a major effort to dominate the cavalry tracked vehicle market. The result was the AMC 34, or Renault YR. Twelve were ordered for trials and the firm continued to develop the vehicle, incorporating the suspension of the R-35, a more powerful engine and a longer track. The resultant vehicle, the AMC 35 or Renault ACG1 was accepted for service and 50 ordered. Final development and production, however, stretched out interminably and by September 1939 only 16 had been delivered, although an additional 25 had also been delivered to Belgium. In fact, the AMC 35 was not what the cavalry wanted. In particular, the range was too short for a cavalry vehicle and the armor deemed too thin, although it was on a level with that of the PzKw III.

Thus, in June 1934 a new specification was drawn up that provided for thicker armor, higher speed and a more powerful armament. This time it was the Somua subsidiary of Schneider that produced a winning design. The prototype was subjected to trials in August 1935 and immediately ordered into production as the S-35. An initial order for 50 was followed by others, so that a total of 450 had been ordered by the start of the war, by which time a new version (S-40) with a more powerful motor had been designed. On paper the S-35 was probably the best tank in the world in 1939, with thick armor, good speed and a powerful gun. In practice, however, the one-man turret slowed

speed. The VM was succeeded by a slightly larger and sturdier version, the AMR 35 or Renault ZT. This latter group was actually divided into several variants depending on the armament. The first contract, awarded in 1934, covered 92 basic ZT-1 and 8 ADF command vehicles. The second contract, in 1936, called for 20 ZT-1 and 5 each of ZT-2 and ZT-3, while the third contract, later in 1936, provided for 55 ZT-1, 5 each of ZT-2 and ZT-3, and 5 ADF. All of these had been delivered by the outbreak of the war. A separate 1936 order was placed on behalf of the colonial troops and covered 21 (later increased to 56) ZT-4 but none had been delivered by September 1939. Most of the hulls were completed by June 1940, but no turrets ever became available, so the vehicles sat in storage.

The initial AMC was the Citroën-Schneider-Kégresse P-16 half track, also known as the M29 when the order was placed in 1929 for 96



squadron of Laffly 50s, were based in the colonies at the outbreak of the war.

The definitive AMD for the metropole was delivered in prototype form by Panhard in 1933 as the Panhard 178. The vehicle quickly proved to be one of the most advanced armored cars of its time and it was standardized in 1935 as the AMD Mle.35. By the outbreak of the war 517 had been ordered and 219 delivered and it had replaced almost all the older armored cars in metropolitan units.

Although the AMD 35 was an excellent vehicle, efforts were launched almost immediately to find an improved replacement. A Gendron 4x4 vehicle with the turret of the AMR ZT-2 was accepted for service in September 1939 as the AM 39, while a very advanced Panhard 8x8 vehicle with oscillating turret was similarly accepted on 1 May 1940 as the AM 40P. Orders for 150 and 600 vehicles, respectively, proved fruitless, as no vehicles were delivered before the fall of France.

For the AMR role the Army had been using the small P-28 half-track armored car, but this had proven inefficient. Renault responded quickly and produced a mockup of their proposal in March 1932. In February 1933 an order was placed for 120 of the vehicles, known as the AMR 33 or Renault VM. It was regarded as an interim vehicle due to its fragile suspension and tendency to throw tracks at high

Right: A pair of P-16 half-track armored cars before the war.



the engagement rate of the gun to a very low level, and it seems unlikely that the old-style suspension would have permitted high cross-country speeds.

The formation of the new mechanized light divisions, which were to use the S-35s, gave rise to another class of cavalry vehicle, however. The organization envisioned a mix of light and medium AMCs, with the Somuas to fulfill the latter role.

Wartime Production

With the outbreak of war in September 1939 it clearly became necessary to focus efforts on the production of a relatively small number of vehicles to maximize efficiency. An order for 200 FCM tanks was cancelled to concentrate resources on the Renault and Hotchkiss light tanks. Similarly, production of the D-2, which had only recently been reinstated, was to be terminated after the current contract for 50 was completed. Maximum effort was to be directed towards increasing the production rate of the S-35 and B-1bis.

In the case of the AMDs, production was

slower than hoped, but not because of problems with Panhard. The supply of APX-3 turrets consistently ran slower than the vehicles themselves. The situation was so bad that on 2 June 1940 the army officially divided the AMD family into two: those with and those without turrets. The June plan called for the production of 15 complete and 40 turretless AMDs. Rather than simply storing the turretless vehicles, instructions were given to fit them with small turrets with 7.5mm machine guns just to get them into the field. Production of the AM 39 was to have started in July 1940, with the AM 40P two years later.

Vichy

The Germans permitted the Vichy Army in the homeland to maintain eight infantry divisions, each of which included a motorized squadron with eight Panhard 178 AMD armored cars. The divisions were intended solely for the maintenance of internal order and to ensure that the divisions would be unable to interfere with any German occupation of the remainder of France, all anti-tank weapons were forbidden.

Thus, the 25mm guns on the AMDs were removed and replaced by a second 7.5mm machine gun. It is possible that some 25mm guns were hidden for possible use later on, but none were so fitted when the occupation came in November 1942.

Sizeable numbers of armored vehicles, albeit mostly obsolete ones, were also held in the colonies. The forces in North Africa held 320 FT tanks (scattered in platoons for airfield and coastal defense, and in support of isolated posts), 107 D-1 tanks (most of them in the two battalions), and 10 H-35s, 16 H-39s and 26 R-35s in the motorized cavalry regiments. Those cavalry regiments also included the 169 armored cars in the theater, consisting of 15 White TBC, 48 Laffly 50, 27 Laffly 80, 21 Laffly S-15 TOE, 22 Panhard 165, 22 Berliet VUDB, and 14 Schneider P-16 half-tracks. There were no armored vehicles in French West Africa until the ill-fated Allied attack on Dakar in 1940. Thereafter the Germans allowed the Vichy regime to ship 22 Somua tanks to that port, and in November 1941 a cavalry regiment with 41 armored cars (including all the VUDBs) was moved from North Africa to that city.

The bulk of the R-35s were based in Morocco where they tangled briefly with invading US forces. Of the remaining vehicles, some were seized by the Germans, while the majority either tried to keep their obsolete vehicles out of the line of everyone's fire or performed limited combat roles for the Allies.

In Lebanon and Syria the tank force comprised 95 R-35 and 45 old FTs. Supporting these were 43 UE chenillettes and 135 older armored cars of many different types. These included about a dozen each of the Citroën-Kegresse M23 half-tracks, Panhard 165/175 TOE, and Laffly 50s. Also in that figure were 39 White armored cars on their last legs, 29 improvised vehicles based on Panhard and Hotchkiss chassis, and about two dozen non-armored light trucks.

To modernize this force the automotive workshop in Beirut purchased 200 Dodge 3-ton truck chassis and 30 Dodge 5-ton chassis. The old and slow White armored cars were to be remounted on the new chassis and salvaged armor and mild steel were to be used to create new armored cars. The initial program called for

Model	1939			1940			
	Prior	Sep-Dec	Jan	Feb	Mar	Apr	May
R-35/40	975	200	30	30	50	15	106
H-35/39	640	130	20	67	22	72	122
D-1	160	-	-	-	-	-	-
D-2	50	-	-	6	17	6	13
FCM	100	-	-	-	-	-	-
B-1	35	-	-	-	-	-	-
B-1bis	315	42	25	27	45	32	42
AMD White TBC	86	-	-	-	-	-	-
AMD Laffly 50	98	-	-	-	-	-	-
AMD Laffly 80	28	-	-	-	-	-	-
AMD Laffly S15 TOE	45	-	-	-	-	-	-
AMD Berliet VUDB	32	-	-	-	-	-	-
AMD Panhard 165/175	30	-	-	-	-	-	-
AMD Panhard 178	219	93	28	8	16	34	98
AMR 33	120	-	-	-	-	-	-
AMR 35 ZT-1	167	-	-	-	-	-	-
AMR 35 ZT-2/3	10	10	-	-	-	-	-
AMR 35 ZT4	-	-	-	3	9	15	13
AMR 35 ADF	13	-	-	-	-	-	-
AMC P-16 M1929	96	-	-	-	-	-	-
AMC Renault 34	12	-	-	-	-	-	-
AMC Renault 35	22	20	5				
AMC S-35/40	270	50	21	16	19	20	22

Deliveries of AFVs



134 new or converted armored cars, with a further 74 planned for the autumn of 1941. It is uncertain how far this program actually progressed before the invasion of 1941, with estimates ranging from 20 to 64 new Dodge armored cars and 15-19 Dodge-White rebuilds. The Dodge armored cars had an open-topped armored body placed on the rear bed on which was mounted a half-turret (open at the rear and top) that carried a short-barrel 37mm gun and coaxial MG. A second MG was carried on a high-angle mount at the rear.

In Indochina about 20 FTs were organized into separate platoons. A small number of White Model 1918 and Panhard Model 1928 armored cars were also present, and some armed UE tractors also showed up, probably a combination of confiscated Chinese vehicles and local improvisations.

Free French Forces

A single tank company with H-39s was formed in the UK in 1940 and used in the invasion of

Above: A new Dodge armored car in Syria (PMK)

Lebanon in 1941. Aside from those and a few old vehicles captured during that campaign the Free French had no armored vehicles until November 1942, when the French Army of North Africa switched sides. Their stocks of elderly AFVs were clearly unsuited to modern warfare and as an interim measure the British turned over 62 Valentines from units converting to Shermans in March and April 1943. The formal rearmament program was established in August 1943 and provided for seven (later six) infantry divisions and four armored divisions, along with eight (later seven) tank destroyer battalions in the expeditionary force to be equipped by the US, and an undefined "sovereignty force" in North Africa to be equipped by the British.

By December 1943 the expeditionary forces had received 503 light tanks (273 M3A3 and 230 M5A1), 594 M4 Shermans, 1,293 M3A1 scout cars and armored cars, 915 M2 and M9 half-tracks, 801 M3 and M5 half-tracks, 35 M4 half-tracks, 78 SP 37mm M6 tank destroyers, 150 SP 76mm M10 tank destroyers, 176 M8 75mm SP howitzers, and 119 SP 105mm M7 howitzers. These figures include in-theater transfers not counted as lend-lease. By June of

1944 the number of Shermans had increased to 636 (368 M4A2 and 268 M4A4), while the number of light tanks remained the same.

British deliveries were made to the forces remaining in North Africa. In 1944 these included 182 Crusader tanks and 30 Marmon-Herrington Mk IV armored cars from in-theater stocks, followed by 84 Centaur I and 40 Crusader III from the UK in the first half of 1945.

Type	Quantity
Light Tank, M3-series	238
Light Tank, M5-series	413
Medium Tank, M4-series (75mm)	755
Half-Track, M2 (APC)	31
Half-Track, M3 (APC)	1,431
Half-Track, M16 (quad .50cal)	70
Half-Track, M21 (81mm mortar)	54
Tank Destroyer, M10	443
SP Howitzer, 105mm M7	283
Armored Car, M8	689
Utility Car, M20	205
Scout Car, M3A1	287

Lend-Lease Deliveries to Free French



Light Tank, FT

Completely obsolete by 1939, the little FT was present in large numbers both in France and elsewhere around the world. The tank had a crew of two, a driver in the front and a commander/gunner/loader in the turret.

Armament consisted of either a single 7.5mm light machine gun or a 37mm SA18 short-barrel gun in the turret, with French tables calling for each platoon to have two cannon-armed and one MG-armed vehicle. Small numbers were also converted to radio tanks, replacing the turret with an armored box, or to carry a short 75mm gun in a fixed mount. With the short range and low speed, the vehicles were suitable only for infantry support, but their weak armament and, in particular, their thin armor made them deathtraps in that role as well.



A machine-gun armed FT, almost completely useless by the time this photo was taken in 1939



Weight (tonnes)	9.6	Front Armor (mm)	35
Length (m)	4.22	Side Armor (mm)	35
Width (m)	1.95	Engine HP	84
Height (m)	2.15	Road Speed (km/hr)	35

Light Tank, Hotchkiss

Originally designed for the infantry, this tank was finally accepted by the cavalry. It was similar to the R-35 (see below), but slightly faster. The main visible difference was the use of six roadwheels, rather than five. The driver sat at the right front with the commander (who was also gunner and loader) in the APX-R turret. Armament was a 37mm SA18 gun and coaxial 7.5mm MG. The H-39 was an improved model with slightly thicker armor and a more powerful engine that caused the rear deck to extend almost horizontally. This increased the speed to 36 km/hr and, because additional fuel was provided, also increased the radius of action by about 10%. Late-production H-39s received a new turret, as in the R-40, with the longer-barrel 37mm SA38 gun, which gave them some anti-armor capability. Overall, they suffered from the same shortcomings as the R-35, p.78.



Weight (tonnes)	12.1	Front Armor (mm)	40
Length (m)	4.22	Side Armor (mm)	40
Width (m)	1.95	Engine HP	120
Height (m)	2.15	Road Speed (km/hr)	36

Hotchkiss H-39 with long gun



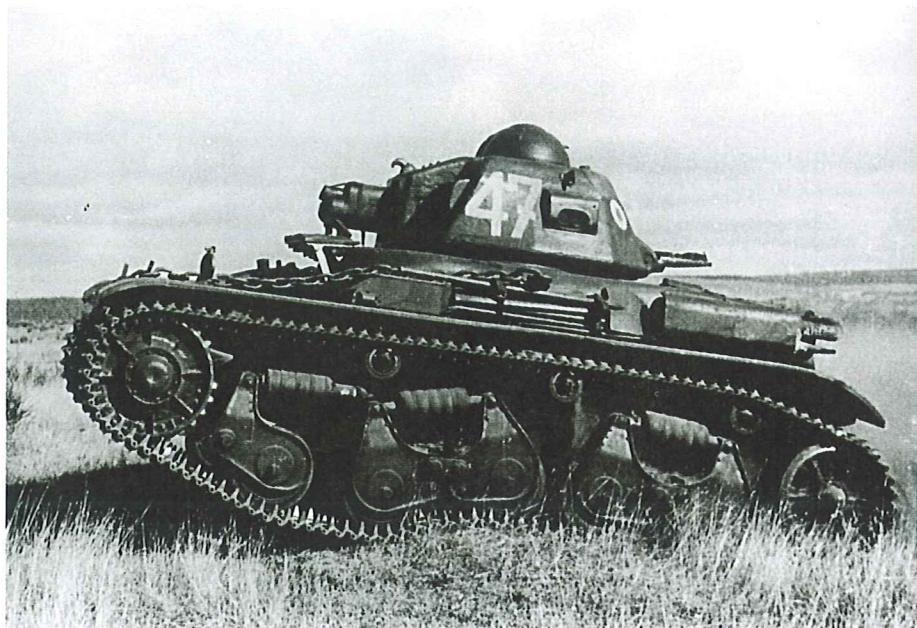
Light Tank, Renault 35/40

The hull of the R-35 was built of three cast sections that were bolted together. The driver sat at the front, slightly offset to the left and had a large flap, also fitted with a vision slot, that opened upward. The one-man APX-R turret housed the commander/gunner/loader, who was provided with a fixed cupola with vision slits. A hatch in the rear face of the turret folded down to provide a seat as well as entry.

Armament consisted of the short-barrel 37mm SA18 gun (with 100 rounds) and a coaxial 7.5mm MG. Detail improvements resulted in the R-40. Later production R-40s used a slightly different turret with the more powerful 37mm SA38 gun, reducing ammunition load to 58 rounds. Armor protection was good, but designed for the slow-motion warfare of WW I trench battles, the design lacked a radio, overloaded the commander with duties, had an ineffectual gun, and was slow and short-ranged.

Top: Renault R-35 light tank (TMB)

Below: An R-35 crossing a stream on early 1940. The gunner/commander is sitting on the fold-out hatch in the turret rear.



	Weight (tonnes)	10.6	Front Armor (mm)	40
	Length (m)	4.02	Side Armor (mm)	n/a
	Width (m)	1.87	Engine HP	82
	Height (m)	2.13	Road Speed (km/hr)	20





Light Tank, FCM 36

This was another tank that competed in the 1933 competition for a light infantry tank and lost out to the R-35. It was more spacious than either the H-35 or R-35 and had a better radius of action thanks to the use of a diesel engine, and featured welded armor. It used a unique FCM turret of welded plates that provided better protection than the AMX-R turret. The turret was larger and provided with a non-rotating cupola at the rear. It was designed to take a more powerful 37mm gun, but when that became available as the SA38 it was decreed that the weapons would go to new production tanks first, so none were retrofitted. The tank was also designed to accommodate a radio, but none were so fitted due to shortages. Thus, with its two man crew, short gun and no radio, it was only marginally better than the R-35s and H-35s with which it shared the battlefield.

FCM light tank

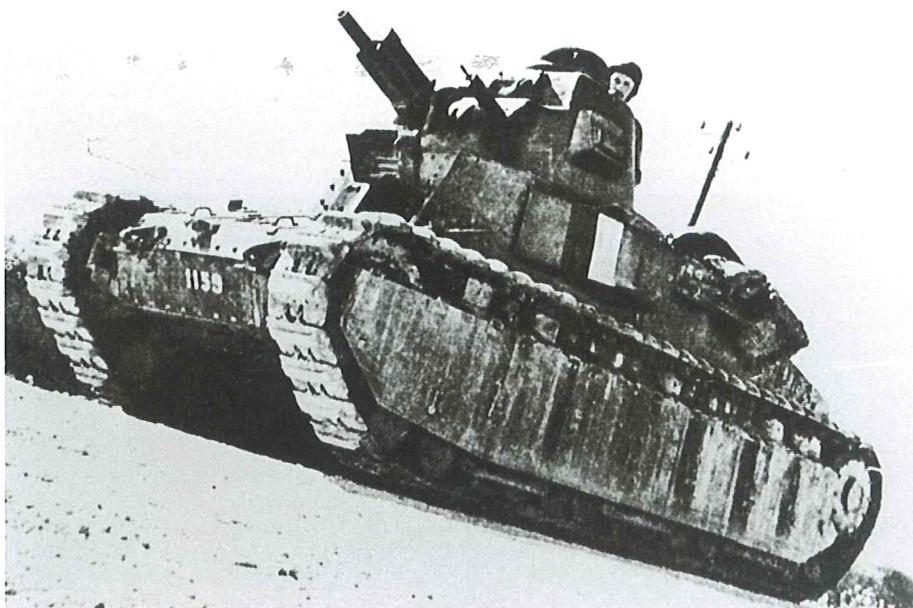


	Weight (tonnes)	12.3	Front Armor (mm)	40
	Length (m)	4.46	Side Armor (mm)	n/a
	Width (m)	2.14	Engine HP	94
	Height (m)	2.20	Road Speed (km/hr)	24

Medium Tank, D

The Renault D-1 was an enlarged outgrowth of the NC-27 with twelve tiny roadwheels each side grouped in fours on long vertical coil springs. The one-man turret carried the medium-length 47mm SA34 gun (for which 112 rounds were provided) and a 7.5mm machine gun. A second MG was fixed in the hull and aimed by turning the tank. The D-2 was similar, but used the AMX-1 turret (as used in the Char B) and later batches of D-2s took advantage of this to fit the more powerful 47mm SA35 gun. An engine of twice the power was also fitted to the D-2, which increased speed slightly from 18 to 23 km/hr. A significant advantage over the other infantry tanks of the French Army was the provision for a radio and an operator (in the hull). On the other hand, its radius of action, at 90 km for the D-1 and 100 for the D-2, was lower than even the short-legged R-35s.

Char D-2 with SA35 gun (PMK)



	Weight (tonnes)	19.8	Front Armor (mm)	40
	Length (m)	5.46	Side Armor (mm)	n/a
	Width (m)	2.22	Engine HP	150
	Height (m)	2.66	Road Speed (km/hr)	23

Medium Tank, B-1bis

The hull was constructed of cast segments bolted together with cross-members and side beams on which the suspension rested. The driver sat at the left front. To his right was a 75mm howitzer that he elevated with a handwheel from -15° to $+25^{\circ}$. Traverse was accomplished by turning the whole tank. The sights were in driver's hood and linked to the gun elevation. The commander was in the APX-4 one-man turret (identical to that of the S-35), where he manned the 47mm SA35 gun and a coaxial MG. Below the commander in the hull center were the loader for the 75mm howitzer and a radio operator. The tank had an advanced hydrostatic steering differential that made possible the infinitely fine steering needed to aim the howitzer. The B-1bis was a powerful tank with thick armor, but the division of crew duties was inefficient, the cross-country range short, and time into engagement with both main weapons was slow.

A Char B-1bis on parade in January 1939



	Weight (tonnes)	31.5	Front Armor (mm)	60
Length (m)	6.37	Side Armor (mm)	60	
Width (m)	2.50	Engine HP	300	
Height (m)	2.79	Road Speed (km/hr)	28	

Cavalry Tank, Somua S-35

The hull consisted of three cast pieces bolted together that provided excellent protection unless a round hit the joint between the upper and lower hull pieces on the side. The driver sat at the front left with a large visor and three vision slots. The radio operator sat at the right front. The third crewman, who served as commander, gunner and loader, was in the APX-4 turret, which mounted a 47mm SA35 gun and coaxial 7.5mm MG. The MG had limited traverse of its own. Rapid turret traverse was electric, with manual handwheels for fine adjustment. The regenerative steering system permitted turns with little loss of speed. The S-35 was well protected, fast, had a good radius of action and a lethal gun. It was rated by some as the best tank in the world at the time, although that seems a bit generous given the limitations of the one-man turret.

Somua S-35



	Weight (tonnes)	19.5	Front Armor (mm)	56
Length (m)	5.38	Side Armor (mm)	40	
Width (m)	2.12	Engine HP	190	
Height (m)	2.62	Road Speed (km/hr)	40	



Scout Tank, AMR-33/35

The two Renault AMR models were small two-man vehicles designed for the scouting role. In the AMR-33, also known as the VM, the armament was a single 7.5mm machine gun and the engine in the front, with the driver at the center and the turret at the rear. The AMR-35, also known as the ZT, was larger, although with the same engine and armor thickness, and could mount several weapons. The ZT1 had a machine gun (7.5mm or 13.2mm), the ZT2 had a 25mm AT gun in the turret, the ZT3 had the same 25mm, but mounted in a casemate, the ZT4 used the turret from the FT tank with machine gun, and the ADF1 was a command vehicle with a radio. In the AMR-35 the engine was at the rear and the driver at the front. Although small and fairly nimble, the thin armor, lack of effective armament and absence of a radio reduced their value as scouts considerably.

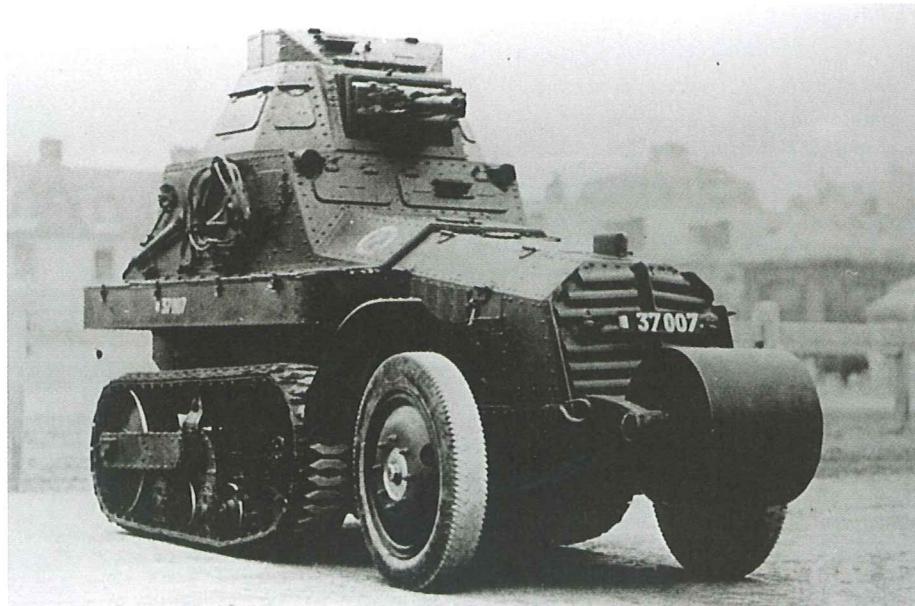
ZT1s with 7.5mm MGs in a pre-war parade



	Weight (tonnes)	5.5	Front Armor (mm)	13
Length (m)	3.50	Side Armor (mm)	n/a	
Width (m)	1.64	Engine HP	82	
Height (m)	1.73	Road Speed (km/hr)	54	

Armored Car, P-16 (M1929)

This small vehicle used the Citroën-Kegresse half-track drive, without power to the front wheels. A large roller was fitted at the front to aid in crossing obstacles. In addition to the driver, the crew consisted of a commander/gunner and a loader. The M1928 trials models had a 37mm gun and MG mounted opposite each other in the turret. The octagonal turret of the M1929 mounted a 37mm SA18 gun and coaxial 7.5mm MG on one face, and had large flaps that could be opened for observation in all others. In 1940 a number of M1929s had the 37mm gun replaced by a 25mm Mle34 AT gun. The vehicle provided excellent observation, critical for a reconnaissance unit, but no radio to get information back to where it was needed. It also lacked the cross-country mobility of a full-tracked vehicle and the speed and reliability of a wheeled vehicle, so fell into disfavor.



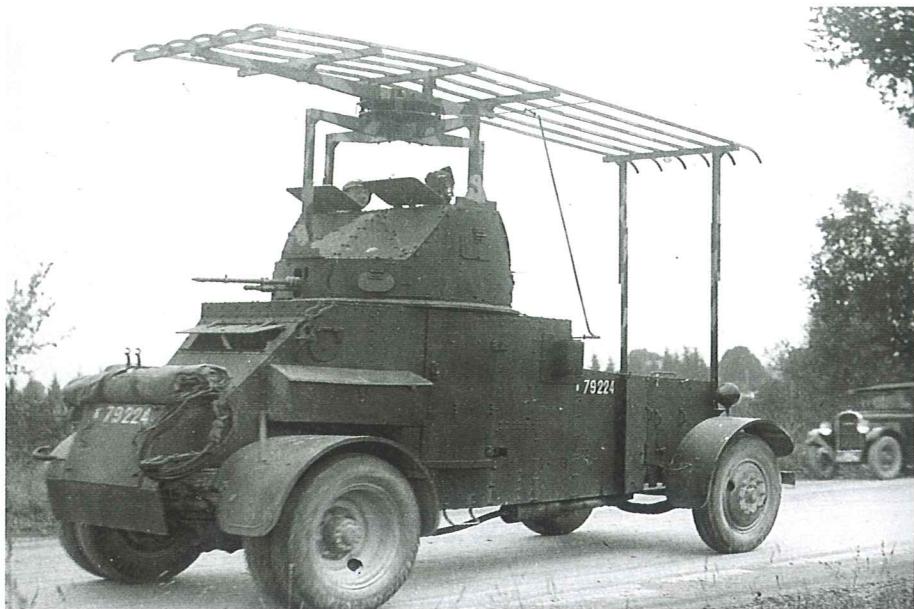
	Weight (tonnes)	6.8	Front Armor (mm)	11
Length (m)	4.83	Side Armor (mm)	n/a	
Width (m)	1.73	Engine HP	60	
Height (m)	2.60	Road Speed (km/hr)	50	

P-16 half-track armored car (TMB)

Armored Car, Laffly

The Laffly 50 was the old White armored car of 1917 mounted on a new 4x4 chassis by Laffly with their 50 hp engine. The Laffly 80 used the 80hp engine and featured a similar, but new, armored hull from Vincennes. The Laffly 50 was armed with a 37mm SA18 and a 7.5mm MG mounted 160° from each other in the turret. The Laffly 80 had a similar arrangement, but used a 13.2mm Hotchkiss heavy MG and an FM24/29 light MG. In both vehicles, the crew was four: a driver, a rear driver for quick reversing, and the commander/gunner and loader in the turret. The only weakness of the Laffly 80 noted in trials was a tendency for the engine to overheat when driven continuously in reverse. Most of the vehicles were based in North Africa, where they served well in the security role.

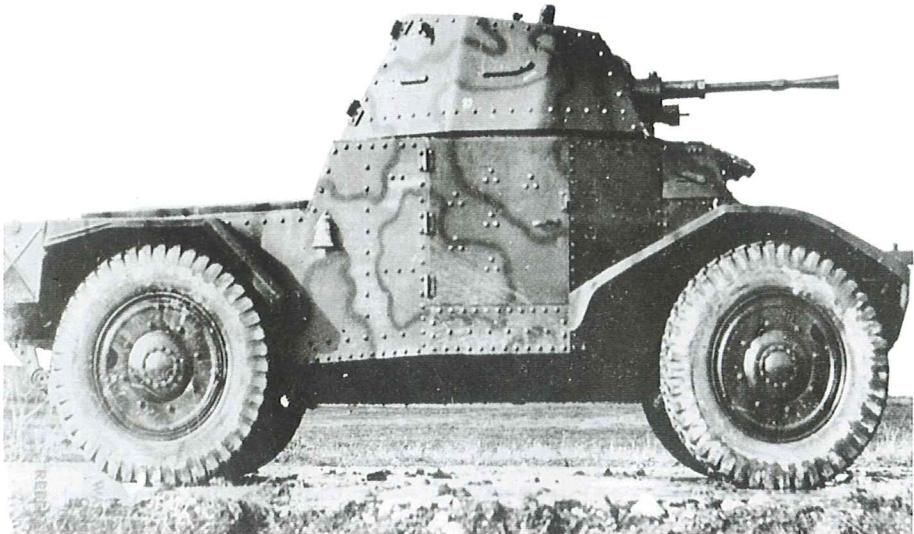
A Laffly 50 fitted as a command vehicle with long-range radio antenna



	Weight (tonnes)	7.5	Front Armor (mm)	20
	Length (m)	5.70	Side Armor (mm)	n/a
	Width (m)	2.10	Engine HP	80
	Height (m)	2.50	Road Speed (km/hr)	80

Armored Car, Panhard 178

This was one of the most advanced armored cars in the world when it was introduced. The crew consisted of a driver at the front center, the commander and gunner in the turret, and a second driver facing rear on the left. The transmission provided four speeds in both forward and reverse. The octagonal APX-3 turret mounted a 25mm SA34 anti-tank gun (for which 150 rounds were provided) and a coaxial 7.5mm machine gun. A small number were built as command vehicles, in which the main gun was sacrificed for a second, long-range, radio. The large wheels and 4x4 drive gave the vehicle good cross-country mobility, although it was a bit tall for a discrete scouting vehicle.



	Weight (tonnes)	8.5	Front Armor (mm)	20
	Length (m)	4.79	Side Armor (mm)	15
	Width (m)	2.00	Engine HP	105
	Height (m)	2.31	Road Speed (km/hr)	72

Panhard 178 AMD



Chenillette, UE

The Chenillette ("small tracked vehicle") was a lightly armored cargo carrier and prime mover for infantry weapons. The configuration was similar to the Carden-Loyd carriers, with the small engine between the two crew members, who were provided with pivoting hemispherical head covers. A tilting removable cargo box was set at the rear and most vehicles were provided with a tracked trailer. An improved version, the UE2, had a four-speed (in lieu of 2-speed) transmission and strengthened differential and suspension. A variant with a small casemate with light machine gun for the vehicle commander was developed and a few shipped to Indochina, but otherwise the vehicle was unarmed in its original state. Later attempts to arm the vehicle with MGs and rocket launchers did not prove very useful except as an expedient.

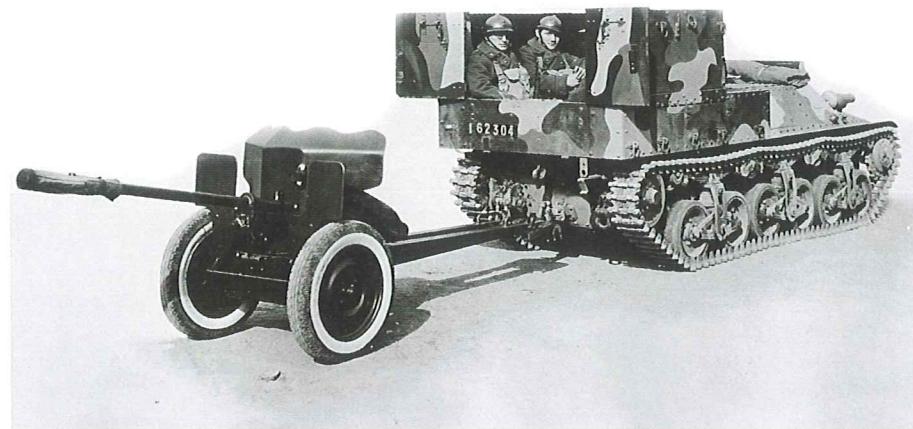


A UE with trailer on its way to the front in 1940

	Weight (tonnes)	2.0	Front Armor (mm)	7
Length (m)	2.70	Side Armor (mm)	7	
Width (m)	1.70	Engine HP	35	
Height (m)	1.03	Road Speed (km/hr)	30	

Tractor, Lorraine 37L

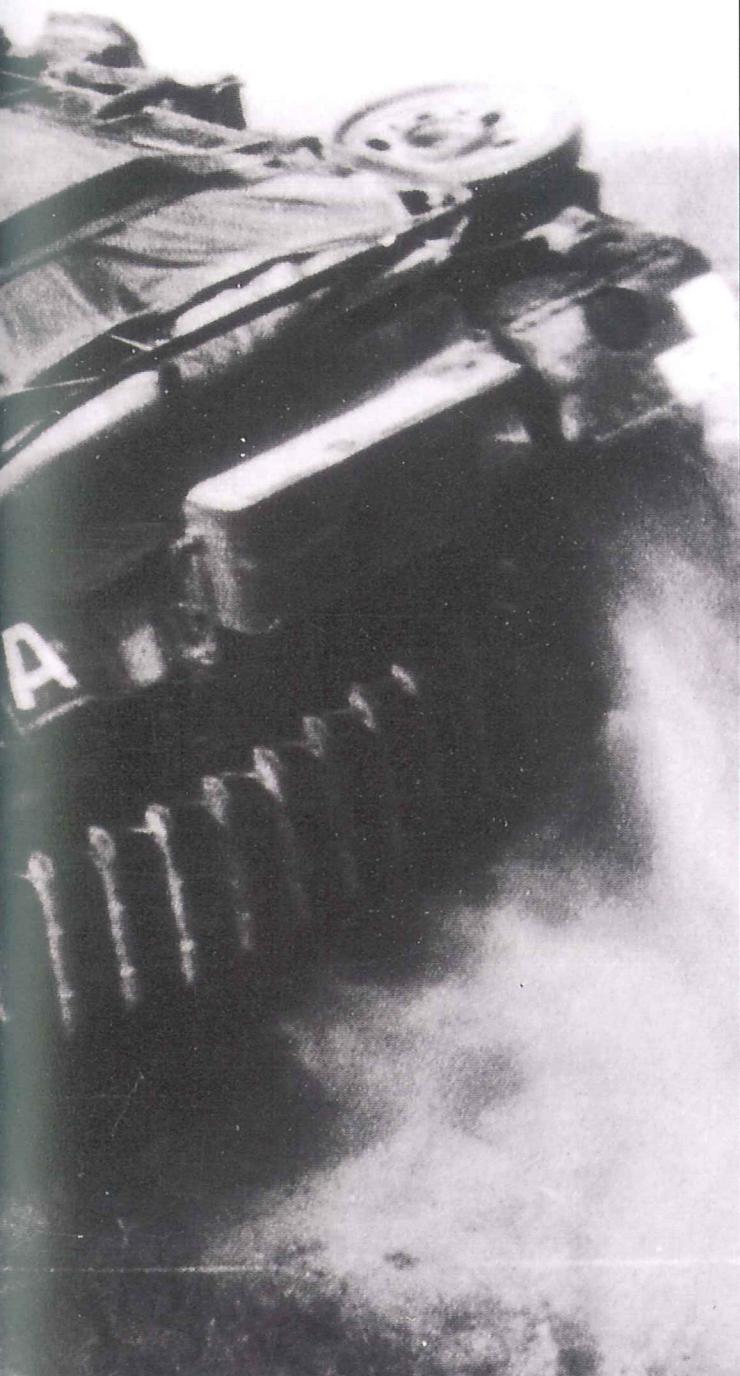
An armored, fully-tracked tractor larger than the UE, the 37L was a multipurpose vehicle adaptable to many roles. The initial version was the Tracteur de Ravitaillement de Chars (TRC) which carried tank ammunition and towed a 565-liter tracked fuel trailer. Twelve such vehicles were assigned to each light tank battalion, and 18 to each B-tank battalion. A second variant was the armored personnel carrier (VBCP) which carried the driver and commander in the front, four infantrymen in a raised rear section, and six more in an armored tracked trailer, an inefficient arrangement. Neither version was armed, although the VBCP was fitted with brackets on the outside of the rear section for an AA mount for the infantry's light MG. A command version was also proposed, and an experimental version with a 47mm AT gun was also fabricated.



	Weight (tonnes)	5.2	Front Armor (mm)	9
Length (m)	4.20	Side Armor (mm)	9	
Width (m)	1.57	Engine HP	70	
Height (m)	1.21	Road Speed (km/hr)	34	

A VBCP towing a 25mm AT gun





Germany

German development of tanks in the interwar period began long before the Nazi party took power. In March 1927 contracts were granted to three firms, Daimler-Benz, Krupp and Rheinmetall, for the production of two experimental tanks each. The six Großtraktor were completed in mid-1929 and secretly shipped to the Kama proving grounds in Russia for tests. In May 1928 contracts were let to Krupp and Rheinmetall for two examples each of a leichttraktor which, on completion in May 1930, were also sent to Kama.

Faults uncovered during the trials were rectified in the next series. Design of a new medium tank, called the Neubau Fahrzeug, was initiated in October 1932 by Rheinmetall and Krupp. For the new light tank Krupp got a March 1933 contract for prototypes, followed by a second contract in July 1933 for 135 armored chassis with the code name Landwirtschaftlicher Schlepper (La.S., or agricultural tractor). To expand the future tank production base, contracts for two La.S. vehicles each were awarded to five additional firms: Daimler-Benz, Krupp, Henschel, MAN and Rheinmetall.

The La.S. evolved into the Pz I light tank and was built both as a tank and, without turret or armament, as a training vehicle (some of which were converted to maintenance vehicles). For heavier vehicles, the Neubau Fahrzeug proved a failure and instead contracts were issued for the development of two vehicles in January 1934. One was the La.S. 100, which became the PzKw II with a 20mm gun, and the other was known as the Zugführerwagen (ZW), which became the PzKw III. A year later, in February 1935 development of the heaviest of the tanks, the Begleitwagen (BW) was begun, that would lead to the PzKw IV.

Before these tanks could be built, however, Hitler had decided to enter the Spanish civil war. A first contingent of 32 PzKw IA and one command vehicle arrived in Spain in October 1936. A total of about 75 PzKw IA and IB, along with four command vehicles, appears to have been delivered. There they proved of limited utility, due mainly to their inability to engage enemy armor except at very close range with hard-core ammunition.

The PzKw I was never intended to be a combat machine, merely to familiarize industry with the building of tracked vehicles and the crews with their operation. The industries they chose were the big ordnance factories, used to working with large, heavy armor and guns. No contracts were awarded to firms that used "hard tooled" assembly lines, the Army



believing that these were too inflexible to meet changing requirements, a preference that was to cost Germany dearly in production later on.

The PzKw II solved, temporarily at least, some of the problems created by the shortcomings of the PzKw I. It was armed with a 20mm cannon that provided some anti-tank capability and it was fitted with a transceiver, making it a more effective reconnaissance machine. A first series of 100 vehicles (models a through c) were built by MAN and Daimler-Benz in 1936-37, followed by the definitive pre-production series (model c), and then the main production series (models A through C) by no fewer than seven firms (MAN, Daimler-Benz, Henschel, Wegmann, Alkett, MIAG and FAMO). A small batch (43 vehicles) of the Model D was built especially for the cavalry, these being substantially different from the earlier models.

Far more significant for the future of the Panzerwaffe were the two heavier tanks. The two were generally similar in size and weight.

Above: A PzKw II (left) and a PzKw 38 (t) (right) during the advance into France, 1940.

The PzKw III was slightly smaller, featured torsion-bar suspension and was intended to mount the 37mm KwK L/46 gun. The PzKw IV was slightly larger, used a conventional leaf-spring suspension and would carry the short-barrel 75mm KwK37 L/24 gun. Intentionally or not, both were designed with plenty of room for growth, both in terms of suspension weight capacity, and in the turret ring that was large enough to accommodate more powerful weaponry. Perhaps most significantly, and often overlooked, was that they introduced the

modern three-man turret, with stations for the tank commander, the gunner and the loader.

Wartime Tanks

Production of the PzKw I had ended in 1937, but attempts were made to wring some last usefulness out of the vehicle by conversion to 47mm and 150mm SPs. These proved only marginally successful, however. Starting in 1943 the majority of surviving PzKw I were converted to ammunition carriers by fitting a steel box in place of the turret, following the example of 51

	PzKw I	PzKw II	PzKw III	PzKw IV
	hull	superstructure	turret	
1933	31	-	-	-
1934	337	54	54	-
1935	811	851	851	-
1936	574	565	557	332
1937	114	255	31	23
1938	-	22	-	106
1939 ^a	-	-	-	102
Total	1867	1747	1493	98
				211

note: PzKw I: hull - superstructure = training vehicles; superstructure - turrets = command tanks

^a to 1 September

German Pre-War Tank Production



ammo carriers built pre-war. A bizarre redevelopment of the tank was ordered in December 1939, when the production of 30 heavily-armored PzKw I was ordered. This featured 80mm frontal armor and a completely redesigned suspension for the weight of 21 tons as the PzKw IF, but no more were built.

With the investment in tooling already made, it was decided to keep the PzKw II in production. To maintain their combat effectiveness, the frontal armor was doubled to 30mm in the new Model F, although complications in the redesign resulted in a production gap between the last of the Model Cs in April 1940 and the first of the Model Fs in March 1941. This was partially filled by the production of 86 flame-thrower versions during that period (plus 26 more later).

An order to completely redesign the automotive components of the vehicle to achieve greater mobility had been issued in June 1938, with MAN responsible for the chassis and Daimler-Benz for the superstructure and turret. The result was the VK901, with a more powerful engine and large, interleaved roadwheels on torsion bars. Only 12 were built in 1941 as the PzKw IIG, along with 22 of a similar, but more heavily armored PzKw IIJ.

The VK901, however, led to the final evolution of the PzKw II, the Model L (Luchs), a dedicated reconnaissance vehicle. An order for 800 vehicles, the first 100 armed with the 20mm KwK and the remainder with the 50mm L/60 gun, was placed but was cancelled in January 1943 after only the first batch of 100 had been completed. The Luchs saw service on the Eastern and Western Fronts, but necessarily in small batches.

The PzKw III performed well in Poland and France, but the armor was a bit thin and the gun was clearly reaching the end of its service as a guaranteed tank-killer. The latter problem had already been foreseen and in 1938 development had begun on a 5cm L/42 tank gun as a replacement. Showing an apparent lack of co-ordination, the infantry was simultaneously developing a 5cm L/60 anti-tank gun. The first 5cm-armed PzKw III, a Model G, came off the production line in July 1940. Shortly thereafter Hitler ordered that all subsequent PzKw IIIs be fitted with the more powerful L/60 model, but this was ignored in order to speed production. In April 1941 Hitler saw a new PzKw III with the short gun and reiterated his order. This yielded the PzKw IIIJ with the 5cm L/60 gun, a weapon that would have proven useful had it

Below: A PzKw III of the 1st Panzer Regiment in Belgium in May, 1940.

been introduced before its actual production start in December 1941. In the meantime, a program had been launched to retrofit the 37mm PzKw IIIs with the L/42 gun, this beginning in March 1941 and by the end of 1942 there were no more 37mm-armed PzKw IIIs in the inventory, except a small number in training and secondary units.

In March 1942 a proposal was put forward to mount the PzKw IV turret. The resultant increase in weight made this impractical, and attention then turned to installing the old 75mm L/24 gun in the existing turret. With the rearming of the PzKw IV, 450 guns and 150 additional barrels were immediately available and these were incorporated into new production PzKw IIIs as the Model N starting in June 1942, and 100 more were subsequently recovered for use in new PzKw IIIJs and as retrofits. By mid-1942 even the 5cm L/60 was losing its effectiveness on the Eastern Front, and the short-barrel 75mm provided greater HE firepower and its HEAT round was better at armor penetration (although less accurate at long ranges). The last PzKw III came off the





	1939 ^a	1940	1941	1942	1943	1944	1945
Production							
PzKw II (2cm)	15	9	233	322	-	-	-
PzKw II (flame)	-	84	-	-	-	-	-
PzKw III (3.7cm)	157	396	-	-	-	-	-
PzKw III (5cm L/42)	-	466	1,673	251			
PzKw III (5cm L/60)	-	-	-	64	1,906	-	-
PzKw III (7.5cm L/24)	-	-	-	450	213	-	-
PzKw III (flame)	-	-	-	-	100	-	-
PzKw IV (7.5cm L/24)	45	268	467	124			
PzKw IV (7.5cm long)	-	-	-	870	3,013	3,126	385
PzKw V Panther	-	-	-	-	1,768	3,777	439
PzKw VI Tiger I	-	-	-	78	649	623	-
PzKw VI Tiger II	-	-	-	-	3	377	100
Variants							
PzKw III Command (unarmed)	44	34	132	14	-	-	-
PzKw III Command (5cm L/42)	-	-	-	81	-	-	-
PzKw III Command (5cm L/60)	-	-	-	36	14	-	-
PzKw V recovery	-	-	-	-	82	227	30
Conversions							
PzKw II (flame)	-	3	3				
PzKw III 3.7cm to 5cm L/42	-	53	285	85	1	-	-
PzKw III 3.7cm to 7.5cm L/24	-	-	-	-	29	8	-
PzKw III to artillery observer	-	-	-	-	225	37	-
PzKw III to 5cm L/42 command	-	-	-	-	104	-	-
PzKw III maintenance	-	-	-	-	-	150	-
PzKw IV L/24 to long	-	-	-	25	-	-	-
PzKw IV to artillery observer	-	-	-	-	-	10	31
PzKw IV maintenance	-	-	-	-	-	36	-

^a Sept - Dec only

German Wartime Production of Tanks

production line in March 1943. Production had peaked in mid-1942 at a little under 250/month, and thereafter it had eroded in favor of the StuG40 assault gun, which was far more lethal.

To increase protection 30mm armor plates were added to the hull and superstructure front at the same time as the 50mm L/42 gun was retrofitted to the Model F and G, and these were added to new Model Hs as they came off the production line. With the Model J, starting in March 1941, the hull and superstructure frontal armor itself was increased to 50mm, eliminating the add-on plates, although the turret frontal armor remained at 30mm until the PzKw III L entered production in mid-1942 when it too was increased, to 57mm.

A number of specialized variants of the versatile PzKw III chassis were also produced. To create command tanks, 30 PzKw IIID, 45

Model E and 145 Model H were completed with additional radios, and the turret bolted in place and fitted with a dummy main gun. Complaints from the field that an unarmed command vehicle was particularly vulnerable led to the development of command versions of the Model J (81 new and 104 converted) and the Model M (50 new) that retained their functional turret and 5cm guns (L/42 and L/60, respectively), albeit with a smaller ammunition load to make room for the radio. A related vehicle was the SdKfz 143 artillery observer vehicle, which sacrificed the main armament for additional radios and plotting equipment. Between February 1943 and April 1944 262 vehicles were converted from older Model E to H tanks for use by armored artillery batteries.

For the projected invasion of Britain in 1940, 168 PzKw III were modified to permit them to operate underwater, crawling on the sea/river

bed via air intakes and exhaust. The conversions, known as Tauchpanzer, retained the characteristics of the basic tanks and eventually simply served as such after being used to cross the river Bug at the start of Operation Barbarossa. Another variant was the flame-thrower tank. A hundred PzKw IIIM were completed with a flamethrower in place of the 50mm gun at the very end of the production run.

The PzKw IV was a slightly longer version of the PzKw III, with the same engine and transmission, but a completely different suspension system. It proved a sound vehicle in the 1939/40 campaigns and the tank production plan, launched in mid-1940, was largely aimed at expanding the number of PzKw IVs. A new factory, the Nibelungenwerk, was begun under the auspices of Steyr-Daimler-Puch, which came on line building PzKw IVs in the last quarter of 1941; while Vomag also set up a new factory for the tank. Simultaneously MIAG expanded its PzKw IV facility. With these, along with the existing Krupp-Gruson line, the PzKw IV was set to become the standard German battle tank for the rest of the war.

Although a sound design overall, the PzKw IV had some weaknesses, especially in terms of firepower and protection. The firepower issue had been discussed shortly before the start of Operation Barbarossa and the envisioned solution consisted of mounting the 5cm Pak38 gun in lieu of the standard short-barrel 75mm L/24. A prototype was fired on 1 August 1941 but the appearance of the T-34 had already rendered this obsolete. Instead a contract was awarded to Krupp on 18 November 1941 to develop a long-barrel 75mm for the tank.

The new tank gun, an L/43 weapon called the KwK40, was cut into production partway through the Model F production run in March 1942. As a result, vehicles completed with the short gun were called the PzKw IVF1, and those with the long gun became the F2. In June it was decided to add 30mm bolt-on armor to a portion of the new production vehicles, and in November the portion was set at 50%, later increased to all new tanks. In August a new version of the KwK40, with an L/48 barrel, was introduced. Armor "skirts" were introduced and detail improvements (many to reduce



Right: A Tiger I, probably on maneuvers in 1944.

production time) were cut into the production run in 1944. With these, the PzKw IV remained in production until the German surrender, albeit at a reduced rate. By that time the tank was starting to show its age. In comparison with the M4 Sherman, the armor was not nearly as well sloped, making it more vulnerable, but its gun was considerably more powerful, remaining a potent weapon to the end of the war.

Planning for even heavier tanks than the PzKw IV had begun several years before the war. In 1937 both Henschel and Porsche were given contracts to develop a new heavier tank. The two manufacturers developed their own designs, the VK3001(H) from Henschel and the VK3001(P) from Porsche. In addition, Henschel developed a heavier version, the VK3601(H). The Henschel designs followed that of the PzKw IV but introduced the suspension with overlapping roadwheels (borrowed from the half-track family) that would become standard on the later German tanks. The Porsche model was more innovative. It utilized a hybrid electric drive, in which gasoline engines drove generators, which powered electric motors at the drive sprockets.

On 26 May 1941 Hitler directed both firms to develop heavier vehicles. The two firms used the experience gained with their earlier efforts to create their new designs, the VK4501(H) for Henschel and the VK4501(P) for Porsche. On 20 April 1942 one prototype of each was presented for Hitler's inspection and in July they were subjected to comparative tests. Both vehicles used a turret designed by Krupp fitted with the 88mm L/56 gun but the portions below that were completely different, Henschel continuing to use the interleaved roadwheel suspension and Porsche the electric drive.

Hitler was sufficiently taken with the revolutionary Porsche design to direct that an order for 90 Porsche vehicles be placed even before the tests were completed. Those tests, however, showed the Henschel design to be the clear winner, due largely to continuing reliability problems with the VK4501(P)'s hybrid electric drive. Nevertheless, production of the VK4501(P) continued and they were eventually completed as Ferdinand tank



destroyers, complemented by one command tank and three recovery vehicles converted from prototype vehicles.

Henschel was given a production contract immediately on the conclusion of the trials and began production at their Kassel plant with little delay. In fact, a first platoon of the new vehicles, now known as the PzKw VI E Tiger, went into action on 29 August 1942. The initial version, having been rushed into production, proved unreliable and underpowered. The initial production run of 424 vehicles, completed between August 1942 and May 1943, were built to this design. When it became apparent that production of the VK4503 Tiger II would ramp up more slowly than hoped, additional orders were placed, totalling 813 vehicles. These were built to a modified design with engine of the PzKw V Panther, which provided an additional 100 hp.

The demise of the VK3001 program did not signal the end of a requirement for a medium tank. This acquired new urgency when reports of the Soviet T-34 began to filter back home. While Henschel and Porsche scaled up their 30-ton VK3001 designs to meet the new heavy tank VK4501 requirement, MAN and Daimler-Benz did the same with some preliminary designs they had been working on in the 24-ton class. The result was contracts to those two firms for a new medium tank to be known as the VK3002 on 25 November 1941. Development of components for the tank had actually begun a

little earlier, Maybach getting the contract for development of a compact 12-cylinder engine in June 1941, and Rheinmetall for a high-performance gun in July.

Trials with prototypes of both models showed that both met the tactical requirements. The main difference was the use of a double torsion-bar suspension by MAN, compared to the leaf spring unit adopted by DB. On 11 May 1942 the Tank Commission recommended adoption of the MAN design as the PzKw V Ausf. D Panther and three days later Hitler concurred. MAN and Daimler Benz were directed to start building the MAN Panther by the end of the year, and MHN and Henschel were started in July 1943.

In fact, MAN did not deliver its first Panther until January 1943 and Daimler Benz the month after that. On the other hand, the other two firms complied with orders to move their production up, MHN delivering their first in February and Henschel in March, although the latter's production was cut short at 130 vehicles so they could concentrate on their Tiger production. The use of brand-new Panthers in the battle at Kursk proved a disaster. The engine proved unreliable and the final drive weak, although suspension worked well and the gun surpassed all expectations. Improved acceptance testing and modification of some components improved the Panther's reliability, although it never exceeded "mediocre" in that category.

Some of the more major modifications were



grouped together and incorporated into a new version called the Panther A, which was cut into production with the 851st vehicle in August 1943. After 2,000 Model As had been built, production switched to the Model G with slightly improved side armor protection and improved reliability in March 1944. A further version, with a narrow-profile turret, was projected as the Panther F, but it the war ended before it could enter production.

In the meantime, work had continued on improving the PzKw VI Tiger. The main impetus for this was the development of the 88mm KwK43 L/71 gun, derived from the Flak41. Hitler ordered that the Tiger follow-on be equipped with this weapon in January 1943, simultaneously directing that it be fitted with 150mm frontal armor and 80mm side armor. Henschel immediately began development and the first prototype ran in October 1943. What was to have been full-scale production started in

January, but it was not until May that monthly output exceeded single digits. The tank, designated the PzKw VI Ausf. B, finally entered service in August 1944. Production never met plans and, in the end fewer than 500 were built.

The two models of Tiger were certainly impressive beasts, highly lethal and well-protected. It has to be questioned, however, whether all the development efforts that went into them might not have been better spent working the reliability bugs and other shortcomings out of the Panther, a much more versatile tank. Similarly, had the production lines at Henschel been given over to Panther production once it became available, the result probably would have provided greater value.

An effort had been made to harmonize the Panther and Tiger tanks. The Panther II was to have used many of the automotive components of the Tiger II and over time the two models were to have grown closer together in terms of automotive components as a means of consolidating component production. The war ended before the Panther II could be put in production, however.

Assault Guns & Tank Destroyers

The Germans were not the only nation to have developed a requirement for an armored close-support artillery vehicle before the war, but they were the only ones to have acted on it, if not with uniform enthusiasm. In June 1936 the official requirement for an "escort artillery under armor for infantry and anti-tank defense" was published and in the Spring of 1938 two vehicles based on PzKw III chassis with dummy guns were trialled by the artillery training regiment. A further five vehicles, with working guns, were completed by mid-1938, when work was stopped for unknown reasons.

The need for such vehicles was validated in the Polish campaign and shortly thereafter an order was placed with Alkett for an initial series of 30 vehicles. Four of the six batteries formed with these vehicles participated in the French campaign, where some technical problems were disclosed but overall their performance was rated highly. In June a contract was placed for an additional 250 vehicles slightly modified as the Model B, and a further 50 were added later. This was followed by 50 Model C and then 150

Above: A Sturmgeschütz 7.5cm Model E advances into the Soviet Union, 1941.



	1939	1940	1941	1942	1943	1944	1945
Production							
StuG 7.5cm (L/24) (SdKfz 142)	-	184	540	90	-	-	-
StuG 7.5cm (L/43 & L/48) (SdKfz 142/1)	-	-	-	702	3,011	3,850	863
StuG IV (SdKfz 167)	-	-	-	-	30	1,006	105
StuH 42 (SdKfz 142/2)	-	-	-	9	204	903	192
Stu Pz IV (15cm) (SdKfz 166)	-	-	-	-	66	215	17
StuG 8.8cm Ferdinand (SdKfz 184)	-	-	-	-	90	-	-
Jagdpanzer IV (SdKfz 162)	-	-	-	-	-	769	-
Pz IV/70(V)	-	-	-	-	-	560	370
Pz IV/70(A)	-	-	-	-	-	207	71
Jagdpanther (SdKfz 173)	-	-	-	-	-	226	198
Jagdtiger (SdKfz 186)	-	-	-	-	-	61	16
StuIG 33B (15cm)	-	-	-	12	-	-	-
Conversion							
StuG 7.5cm (L/43 & L/48) (SdKfz 142/1)	-	-	-	-	-	173	-
StuG IV (SdKfz 167)	-	-	-	-	78	-	-
Stu Pz IV (15cm) (SdKfz 166)	-	-	-	-	8	-	-
Stu Mrs Tiger (38cm)	-	-	-	-	-	18	-
StuIG 33B (15cm)	-	-	-	12	-	-	-

Production of Assault Guns & Tank Destroyers

Model D. The final version was the Model E, designed to replace the light armored half-track previously used by the assault gun battery commanders. It featured additional radio equipment and a stowed stereoscopic scissors periscope.

The inadequacies of the 75mm L/24 gun against armor had been realized before the war. Krupp received a contract for the development of a 75mm L/42 gun in January 1939, and a prototype was tested in June 1940. The gun was actually an L/40 weapon and was shown in a prototype assault gun in March 1941. For unknown reasons development of this gun was halted in November 1941 in favor of an L/43 design by Rheinmetall. After a short production run this, in turn, was replaced by an L/48 version, with both firing the same ammunition as the standard 75mm Pak40 and both, confusingly, designated the StuK40.

When fitted with the new long-barrel StuK40 the assault gun became known as the Sturmgeschütz 40 Model F (SdKfz 142/1). In the early summer of 1942 Hitler began demanding that all StuGs should have an additional 30mm of frontal armor, believing that any loss in mobility due to the additional weight was acceptable due to their infantry-support role. Starting in July 1942 all StuGs produced had 30mm armored plates welded to

the front portions of the hull. In September the Model F/8 was introduced that used the lower hull of the PzKw IIIJ, then the current production model. The Model F/8 was replaced by the definitive version, the Model G in December 1942.

With the introduction of the long-barrel 75mm gun the assault gun's primary role changed from infantry support to that of tank destroyer. Although necessary due to the large number of enemy (particularly Soviet) tanks rolling into German infantry formations, it left the infantry without the close HE support originally envisioned by the assault gun concept. Planning for an infantry support version began almost in parallel with that of the long-barrel 75mm, in the autumn of 1941. A prototype Sturmgeschütz with a 10.5cm light howitzer was shown in March 1942 and an initial test series of 10 vehicles was built in the summer. Deliveries of full production vehicles, now known as the Sturmhaubitze 42, began in March 1943. In that month a new organization table was published for the assault gun units that authorized batteries to have either 10 StuGs or 7 StuGs and 3 StuH. The StuH42 proved an effective vehicle and remained in production almost to the end of the war, but was apparently more popular with supported infantry than with the vehicle crews, who felt defenseless

against the tide of enemy armored vehicles. The vehicles were provided with a hollow-charge round for use against enemy tanks, but its lofted trajectory made hitting a target at anything but close range something of a gamble.

Production of the StuG40 was severely disrupted by a November 1943 air raid that brought a temporary halt to the delivery of PzKw III chassis. The StuGs were considered so vital to the war effort that in December Hitler approved a suggestion to mount the StuG superstructures, which were still being built, on the chassis of PzKw IV tanks. The result was the Sturmgeschütz IV, which remained in production to the end of the war, even after StuG 40 production restarted.

The heaviest assault gun, the Sturmgeschütz 8.8cm (SdKfz 184), also known as the Ferdinand and the Elefant, resulted from Hitler's frustration at not being able to mount the long-barrel 88mm Pak43 in the Tiger I tank. In compensation he demanded that a heavy assault gun be built in time for the Kursk offensive. The solution was to use the 90 chassis already built for the failed Tiger(P) and mount a heavy superstructure and gun. Only the 90 were built as a one-off production run to satisfy this demand.

As the assault guns moved towards the anti-tank role development of vehicles specifically designed for the tank destroyer role came to the fore. The first was initially known as the Sturmgeschütz neuer Art 7.5cm auf PzKw IV, but was later named the Jagdpanzer IV (SdKfz 162) indicating its primary role more clearly. Production ran through November 1944 at a moderate rate, although it was opposed by General Guderian on the basis that it reduced production of the more versatile PzKw IV tank.

If the role of such vehicles was now to be that of a dedicated tank killer, it made sense to give it the best anti-tank weapon available. The result was the development of two tank destroyer versions of the Jagdpanzer IV mounting the L/70 75mm Pak42 gun as used by the Panther. Two models of the Jagdpanzer IV/70 were produced, one by Vomag and one by Alkett, starting in August 1944. They were first used en masse in the Ardennes offensive, then switched to the Eastern Front.

The ultimate tank-killer was developed as the result of a 2 October 1942 order specifying a



	1940	1941	1942	1943	1944	1945
Production						
7.5cm Pak 40 auf RSO	-	-	-	60	-	-
7.5cm Pak 40 auf PzKw II (SdKfz 131)	-	-	372	204	-	-
8.8cm Pak43/1 auf PzKw III/IV	-	-	-	345	133	16
Conversion						
4.7cm Pak (t) auf PzKw I	202	-	-	-	-	-
4.7cm Pak (t) auf 35-R	-	174	-	-	-	-
7.5cm Pak 40 auf Lorraine (SdKfz 135)	-	-	170	-	-	-
7.5cm Pak 40 auf FCM	-	-	-	10	-	-
7.5cm Pak 40 auf 39-H	-	-	24	-	-	-
7.5cm Pak 40 auf Somua [half-track]	-	-	-	-	16	-
7.5cm Pak 40 auf PzKw II (SdKfz 131)	-	-	-	75	-	-
7.62cm Pak 36r auf PzKw II (SdKfz 132)	-	-	193	8	-	-

Self-Propelled Anti-Tank Gun Production

Panther chassis mounting the 8.8cm Pak43 (L/71) gun. An excellent, well-balanced design, the Jagdpanther was late in getting into production as a result of continued indecision on who should produce it. It was designed by Krupp with the intention it would go into full production in July 1943, but Speer switched the effort to Daimler-Benz with the intent that they produce it. The final design was produced in May 1943, but production responsibility was then switched to MIAG and their production did not begin until January 1944. Two other producers were brought in with the intention of increasing production to 150 per month, but in fact the highest achieved was 72 in January 1945.

Proving that any good concept can be taken to an illogical extreme, orders were given in early 1943 to mount a 128mm anti-tank gun on the chassis of the Tiger II tank. The result was the Jagdtiger (SdKfz 186). The initial effort to use the Porsche suspension failed, delaying the project, and the first vehicle was not delivered until July 1944. Only 77 were delivered, these being used by one heavy tank battalion and one heavy tank destroyer battalion.

As the original assault gun role migrated to that of tank destroyer a void was left for the mission of close HE support of the infantry. As the German war machine turned to the defensive, the required numbers grew ever smaller, but some need still remained. An interim solution was found by mating the 15cm sIG on the chassis of the PzKw III. Unlike the earlier SP infantry guns, this was a full assault

gun, with a completely enclosed and heavily armored superstructure. Twenty-four were built in October 1942 and they were sent to the Eastern Front.

In early 1942 Alkett was ordered to develop the definitive assault gun, using (again) the 15cm sIG but this time on the PzKw IV chassis. After viewing a prototype, Hitler ordered production of 40-60 vehicles in October. Production began in March 1943 as the Sturmpanzer IV (SdKfz 166). An effective close-support vehicle, production of the Sturmpanzer IV continued to the end of the war.

Self-Propelled Anti-Tank Guns

Unlike the assault guns and SP artillery that resulted from pre-war tactical requirements and a comprehensive (if not always efficient) development program, the SP anti-tank gun family was a more opportunistic reaction to the availability of chassis and guns.

The first of these came from an order in late 1939 for Alkett to convert 132 PzKw IB light tanks, by now almost useless, to SP anti-tank vehicles by removing the turret and placing a captured Czech 47mm gun on top, with a shield. Alkett completed the first 40 in March 1940, then 50 in April and 42 in May, permitting the formation of five independent AT battalions in time for the campaign in the West. Other firms were subsequently brought in to bring the total to 202 and they served in all theaters until 1943. A similar vehicle was built using the chassis of captured R-35 tanks. This

vehicle was more heavily armored and the rear of the superstructure was closed in, but it was also slower, being based on an infantry tank. A total of 200 were ordered (of which 26 were unarmed command versions) and the work was accomplished in May to September 1941. All served in France or adjacent areas.

By late 1941 it was becoming apparent that the 47mm Pak was no longer the tank-killer it had been 18 months earlier. The 50mm Pak was not that much of an improvement, but two new weapons promised a solution. Development of a 75mm anti-tank gun had begun in 1939 and Rheinmetall turned out the first of them in February 1941. It would take a while for production to ramp up, so as an expedient several hundred 76.2mm M1936 field guns captured on the Eastern Front were ordered converted to AT guns, a successful effort that began yielding fruit in April 1942. Even before production of these two pieces began, efforts were already under way to mount them on the chassis of obsolescent tanks.

The order to develop a mounting for the 7.62cm Pak36r on the chassis of the PzKw IID (which had gone out of production in August 1939) was given to Alkett on 20 December 1941. An initial order for 150 SdKfz 132 conversions was delivered in April and May 1942. An additional 60 conversions were ordered, but this does not appear to have been fully completed. In the meantime, the utility of the current PzKw II, the Model F, was called into question and in June 1942 it was decided that 50% of the PzKw IIF production should be given over to the production of 75mm SP AT guns in a configuration very similar to that used by the SdKfz 132. In July this was raised to 75% and a total of 576 SdKfz 131 Marder IIs were built between July 1942 and June 1943, when production was halted in favor of the Wespe SP howitzer. A further 75 vehicles were converted from existing PzKw IIF in late 1943.

Although the conversions were rather crude, they did provide armored mobility for powerful guns and similar conversion efforts were undertaken for the troops in France, for whom first-line equipment would not be available. Small numbers of captured H-39 and FCM were given a similar treatment, but much more common were conversions based on the more suitable Lorraine tractor with its open rear



compartment. Another parallel effort was a similar production effort using the PzKw 38(t) chassis, described in the Czechoslovakia section.

Two anomalous projects involved mounting the 75mm Pak40 on unusual chassis. One, implemented in October 1943, put the gun with its shield on the rear bed of a very lightly armored RSO tractor. With almost no protection for the crew and a top speed of only 17 km/hr, this did not prove practical. An apparently local project in France mounted the gun on the rear of an armored version of the Somua MCG, a captured half-track. Only a few were built.

The various projects for the 75mm and 76mm guns were a useful expedient, but their great height and open fighting compartments made them vulnerable and by late 1942 interest was turning to the assault gun configuration, with its lower profile and better protection. Only one further SP AT gun would be placed in production.

The exception was the Hornisse (later Nashorn), which was designed in 1942 to provide armored mobility for the extremely potent 88mm Pak43 gun. The only chassis capable of handling such a weapon was that of PzKw IV, and in fact the Hornisse used many of the features of the Hummel 15cm SP howitzer. Deliveries began in May 1943, although they were not declared ready for service until a few months later due to a faulty travel lock for the gun. The Hornisse were issued to six independent tank destroyer battalions that served effectively on all fronts.

Self-Propelled Artillery

The Germans were early entrants into the field of SP artillery, albeit in a rather half-hearted way. In March 1940 Alkett converted 38 PzKw IB chassis to the artillery role by removing the turret and building up a huge superstructure into which was set the 15cm sIG infantry gun. The vehicle could be used in the indirect fire mode, but it was more commonly used as a direct-fire weapon in spite of its thin armor. They were used in the French campaign of 1940 and the concept proved sound, but the actual vehicles were far from ideal.

The replacement used the PzKw II made wider and longer, with an additional roadwheel each side. This permitted the gun to be mounted much lower than in the original version. Although much superior to the earlier PzKw I-based vehicle, only 12 were built in 1941 and all were dispatched to North Africa, where they served until early 1943. In the meantime, interest had turned to better-protected vehicles that could serve right up in the front lines. The original concept of a SP infantry gun thus evolved into a heavy assault gun, and those vehicles are covered separately.

The development of SP artillery had been envisioned as early as 1934, but by 1935 attention had turned to a tank with a 105mm howitzer. Thus, it was not until early 1940 that approval was given for development of a true SP artillery piece. In January 1942 Krupp showed a prototype of a 105mm howitzer on the PzKw IV chassis and in July a contract for 200 was placed. This was to be an interim design, as the

Automotive Design Office really wanted a weapon with 360° traverse and capable of dismounting for use separate from the carrier vehicle. This resulted in the "Heuschrecke 10" vehicle with a light howitzer in a dismountable turret. In the meantime, however, it had become clear that the interim design was both heavy and expensive and Rheinmetall and Alkett were called upon to mount the 105mm howitzer on the chassis of the PzKw II light tank. Using experience previously acquired in mounting the 15cm infantry gun and the 75mm Pak on this vehicle, they demonstrated the vehicle in July 1942. The contract for the PzKw IV SP vehicle was thereupon cancelled. In fact, the Heuschrecke 10 never entered series production, and the Rheinmetall/Alkett SdKfz 124 "Wespe" soldiered on to the end of the war.

The companion heavier piece to the Wespe was the 15cm sFH18/1 howitzer on a hybrid PzKw III/IV chassis. Approval for development was given to Alkett in July 1942 and a prototype shown in October, along with the very similar Hornisse SP anti-tank gun. The first production vehicle came off the line in January 1943 as the SdKfz 165 "Hummel". For the most part they served in mixed battalions, one per panzer division, with two 6-gun batteries of Wespe and one of Hummel.

In the meantime the availability of captured chassis in France led to the conversion of significant numbers into SP artillery for the use of local forces. Most of the chassis were too small to handle anything larger than the 105mm howitzer and were actually marginal for that role. In particular, a reluctance to undertake extensive modifications left the engine at the rear, which limited the maximum elevation of the piece, and hence the range. The one exception was the Lorraine tractor, which had a large, open bed at the rear. The usefulness of the Lorraine with the 15cm howitzer was such that it was the only one of the French conversions to be shipped out of theater, with one battalion going to the 21st Panzer Division in North Africa.

Self Propelled Air Defense Vehicles

Unarmored half-tracks were used to carry 20mm AA guns early in the war, but their front-line utility was limited. In 1943 a series of PzKw 38(t) variants with a 20mm gun were built by

	1939	1940	1941	1942	1943	1944	1945
Production							
15cm sIG auf PzKw II	-	-	12	-	-	-	-
10.5cm leFH 18/2 auf PzKw II (SdKfz 124)	-	-	-	-	514	162	-
15cm sFH 18/1 auf PzKw III/IV (SdKfz 165)	-	-	-	-	368	289	57
Munitionstraeger Wespe	-	-	-	-	104	55	-
Munitionsfahrzeug Hummel	-	-	-	-	96	61	-
Conversion							
15cm sIG auf PzKw IB	-	38	-	-	-	-	-
10.5cm leFH 18 auf 39H	-	-	-	48	-	-	-
10.5cm leFH 16 auf FCM	-	-	-	12	-	-	-
10.5cm leFH 18/3 auf B-2	-	-	-	16	-	-	-
10.5cm leFH 18 auf Lorraine	-	-	-	12	-	-	-
15cm sFH 13/1 auf Lorraine	-	-	-	94	-	-	-

Production of Self-Propelled Artillery



	1943	1944	1945
Production			
Möbelwagen	-	205	35
Conversion			
Wirbelwind	-	100	5
Ostwind	-	15	28

SP Anti-Aircraft Production

BMM, but by then the weak firepower of the single 20mm had become apparent and they were not judged completely successful. A proposal to mount the quad 20mm on the PzKw IV chassis was initially rejected by Hitler in May 1943, but by the end of the year he had relented. On 28 January 1944 the decision was made to use the 37mm gun in lieu of the quad 20mm and the first twenty vehicles were produced in March. Known as the FlakPanzer IV Möbelwagen ("moving van") because of its ungainly appearance, the drop sides left the crew vulnerable in action and the Inspectorate for Panzer Troops demanded a modification to include an armored turret.

The result was the "Wirbelwind", a PzKw IV chassis with an open-topped octagonal turret mounting the quad 20mm gun. The first vehicles were delivered in August 1944 and these, like subsequent vehicles, used repaired and rebuilt chassis rather than new production. A modified version, using the 37mm Flak43 gun, was also developed and a contract for 100 vehicles was placed in August 1944. This vehicle, known as the "Ostwind", entered production in November 1944.

Although the Wirbelwind and Ostwind were successful designs, the development of more advanced concepts ran in parallel with their production. The most promising of these was the Kugelblitz, which featured an enclosed turret with twin 30mm Flak103/38 guns and a stereoscopic range-finder for the commander. An advanced design, only five pre-production vehicles were built before the war ended.

Armored Cars

The Reichsheer launched their initial foray into armored cars with two families of conversions of civilian chassis. The light family was based on the Adler 4x4 passenger car chassis fitted by Daimler-Benz with an open-topped 8mm thick

armored body. There were two versions, the Kfz.13 with a single shielded machine gun on a pintle-mount, and the Kfz.14 which replaced the gun with a long-range radio with frame antenna. Their cross-country performance was not good and only 147 Kfz.13 and 40 Kfz.14 were built during 1932-1934. A few were still in service for the French campaign of 1940, but were withdrawn shortly thereafter.

For the heavy armored car family the decision was made to use three nearly-identical 6x4 truck chassis by Daimler-Benz, Büssing-NAG and Magirus. This family consisted of the SdKfz 231 armored car with a 2cm gun and coaxial MG in a turret, the SdKfz 232 which added a long-range radio and frame antenna above the turret, and the SdKfz 263 which deleted the turret in favor of a superstructure extension, a frame antenna and a telescoping mast antenna. These vehicles were in production from 1932 to 1937, during which time 123 SdKfz.231/232 and 28 SdKfz.263 were built by the three firms, with Magirus the largest contributor. Their 6x4 drive gave them mediocre off-road performance and they were withdrawn from service in 1940.

The replacement for the light armored car family was developed in 1934 based on the Horch 801 chassis with its 4x4 drive and rear-engine configuration. Three members of the family initially went into production. The SdKfz 221 (339 built 1935-40) was armed with a machine gun in an open turret, the SdKfz.222 (989 built 1936-43) featured a turret with a 2cm KwK30 or KwK38 automatic cannon and a coaxial MG, and the SdKfz.223 (550 built 1935-44) was a radio version similar to the SdKfz.221 but fitted with a frame antenna and with the turret further to the rear to provide room for the larger radio.

The replacement for the heavy armored car family was a pair of large 8x8 vehicles, confusingly given the same designations as the earlier 6x4 units they replaced. To distinguish the two, the earlier vehicles had "6-rad" appended to the designation, and the later ones

"8-rad". The first two to enter production were the SdKfz.231 and 232 armed with a 2cm gun in a turret, the latter also including a long-range radio and frame antenna. A total of 607 were built between 1936 and September 1943. A special signals version in which the turret was replaced by a built-up superstructure for radio gear entered production in April 1938 for use with the signal battalions of the panzer and motorized divisons, with 240 being built to April 1943.

Half-Tracks

The Army had developed a range of successful, if somewhat complex, half-tracks for towing and cargo-carrying duties in the 1930s. These ranged from the small 1-ton SdKfz 10 (Demag D7) to the huge 18-ton SdKfz 9 (Famo F3). Among the first to act on the emerging requirement for a family of light armored vehicles, they selected the D7 and the 3-ton SdKfz 11 (Hanomag H kl 6) for fitting with armored bodies.

The larger vehicle offered greater opportunities and went into production first. The basic version, the SdKfz 251/1, was an armored personnel carrier with room for 12 (including the driver). Other versions developed included pioneer, artillery observer/survey, and heavy weapons models. This family of vehicles equipped the armored infantry, providing them with a very useful range of vehicles. They first saw widespread use in the opening phases of the war against the USSR and continued in use and production to the end of the war.

The smaller vehicle family was used mainly for reconnaissance units. Although useful, their utility was limited by their small size, such that the basic APC (the SdKfz 250/1) could only carry six men, sufficient for scouting but too small for regular infantry use. Because of this the SdKfz 250 family entered production later and its proportion of half-track production declined from 1942 onwards.

Despite relatively high production levels, losses of these thinly-armored vehicles were also

â	1939	1940	1941	1942	1943	1944	1945
SdKfz 250	389	1,374	2,895	1,701	269		
SdKfz 251	232	337	813	2,574	7,153	9,486	1,285

Armored Half-Track Production



heavy. Thus, by December 1943 although 15,700 had been built only 6,589 were in service with the troops, comprised of 2,934 SdKfz 250 (including 305 SdKfz 250/9 and 127 SdKfz 250/10) and 3,655 SdKfz 251 (including 266 SdKfz 251/9 and 146 SdKfz 251/10).

Captured Vehicles

The first batch of captured vehicles fell into German hands with the conclusion of the Polish campaign. Few of these vehicles appear to have been recovered intact, and only about a dozen TKS tankettes and a few armored cars appear to have been used, and those only for a brief time.

The fall of France was another matter. About 500 FT-17, 800 Renault 35 and 40, 600 Hotchkiss 35 and 39, 50 FCM 36, 160 Renault B-1 and 300 Somua S-35 appear to have been recovered in fairly good condition, sent to collection points, and repaired and refurbished as needed. The FTs were handed over to security units for local defense of airfields and factories.

The favored models of tanks were apparently the Somuas and Hotchkisses. The creation of tank units equipped with French tanks began in December 1940 and by mid-1941 there were two brigades each of two regiments. It is not clear if the Germans initially planned to use these units operationally, but it certainly became clear after experience that the French tanks were incompatible with panzer tactics, in

particular the one-man turret prevented the kind of efficient operation they expected. As a result the four regiments remained in France as training units for the most part, sending out only small detachments for security duties to the Balkans and Norway. As the threat of an Allied invasion of France increased, the tank units there were re-equipped with German tanks until, by the time of the Normandy invasion, there were only a few dozen left in service with first-line units. The remainder were largely scrapped or converted to self-propelled mounts.

Relatively few of the R-35/40s appear to have been taken into German service. A number were handed out to other Axis nations as aid of questionable value, and probably about a hundred were used for security duties in France, but little other use seems to have been made of them. Instead, 200 were converted to anti-tank and command vehicles and most of the others converted to towing tractors. Of the B-1s about 60 were converted to flame-throwing tanks and 16 converted to SP howitzers. The remainder were briefly used as training tanks and a few were issued to troops on the Channel Islands. One company of regular and flame-thrower B-1s were deployed to the Eastern Front in 1942, but this was their only front-line combat use.

In addition to the tanks the Germans also

Left: The radio signals version of the light armored half-track, the SdKfz 250/3 here in France.

captured about 3,000 chenillette UE light armored vehicles. They found them useful for local use but too delicate for extended operations. As a result, they only rarely left France, where they were used for towing duties and, fitted with a small armored cab and a light machine gun, for security duties.

One French type that saw widespread, if relatively short-lived, service was the Panhard 178 AMD. About 250 were captured and refurbished and two armored reconnaissance battalions were equipped with 50 vehicles each for Operation Barbarossa. They appear to have been a bit fragile for the long, heavy going of the Eastern Front for within a few months most had been lost. Thereafter they were assigned to security units and railroad guard duties. The occupation of Vichy France brought a further 45 vehicles into the German fold, but these had been modified (under German direction) by replacing the 25mm gun with a second MG. New turrets with a 50mm gun were fitted to some and they served in the West into 1945.

Surprisingly few Soviet armored vehicles were taken into service despite the huge number captured in 1941 and 1942. Only a few dozen T-34s were used, along with a smaller number of T-26s. The Komsomolyets tractor was taken by individual units as towing vehicles, but there does not appear to have been a comprehensive effort to refurbish or resupply them. The same was true of the armored cars, the capturing unit would use a few until the lack of spares rendered them useless.

The German Army not only took over all the armored vehicles it could from the Italian Army in September 1943, but also kept the Fossati plant running, building new vehicles. Vehicles acquired up to the end of October 1944 consisted of: 17 L-3/35 and 15 L-6/40 light tanks; 28 M-14/42 and 97 P-40 tanks (of which 40 P-40s lacked motors); 74 semoventi 47/32, 55 semoventi 75/18, 88 semoventi 75/34, 6 semoventi 75/46 and 84 semoventi 105/25; 32 M-14/42 command vehicles; 23 AB-41 and 48 AB-43 armored cars; and 78 Lince scout cars. Production after this date was minimal due to Allied bombing and difficulties in supplying materials.



PzKw I Tank (SdKfz 101)

Originally known as the La.S. (agricultural tractor) to disguise its development, the PzKw I was the first of the post-WW I German tanks. Armament consisted of two 7.92mm machine guns mounted coaxially in a hand-operated turret. The PzKw IA proved to be underpowered and prone to engine overheating and was replaced on the production line by the PzKw IB after 818 had been built. The PzKw IB featured a lengthened chassis with an extra roadwheel and replaced the previous 60-hp air-cooled Krupp engine with a 100-hp water-cooled Maybach unit. The PzKw I had a receiver only, transmitting sets were carried in special command vehicles with a tall fixed superstructure. With thin armor and MG armament, the PzKw I was obsolete by the start of the war, but soldiered on for the next year for lack of alternatives. A few were converted to SP carriers, but were really too small for this role.

PzKw I light tank (PMK)

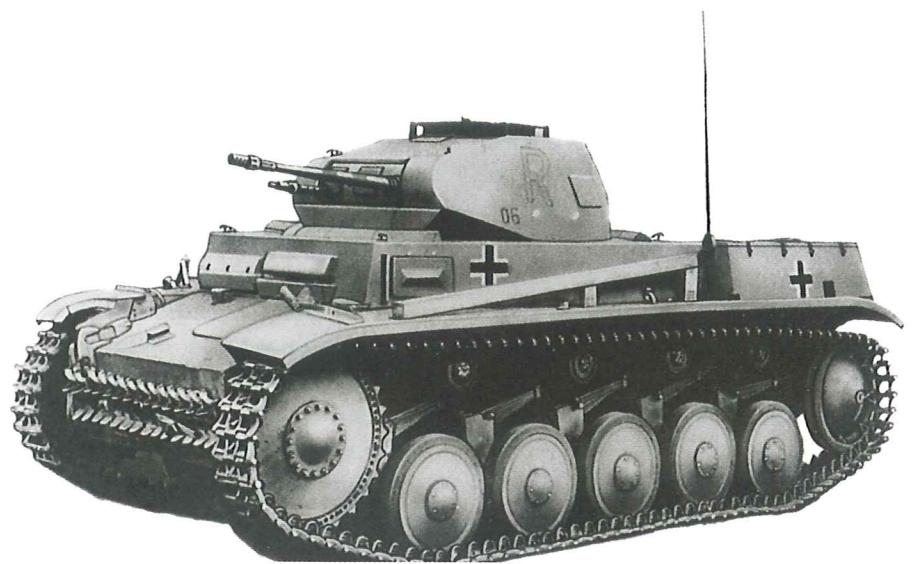


	Weight (tonnes)	5.8	Front Armor (mm)	13
	Length (m)	4.42	Side Armor (mm)	13
	Width (m)	2.06	Engine HP	100
	Height (m)	1.72	Road Speed (km/h)	40

PzKw II Tank (SdKfz 121)

The successor to the PzKw I in the light tank role, this was a much more capable machine. The first hundred (models a and b) were developmental models. The model c adopted the new suspension with five independently-sprung roadwheels and the follow-on models A, B and C introduced a new transmission. Additional 20mm armor plates were attached to the front of models c to C between the Polish and French campaigns. The model D added a seventh gear to give a higher road speed (55 km/hr) and a new suspension for the cavalry. The later model F reverted to the model C configuration but had thicker frontal armor (30mm). All were armed with a single 2cm KwK30 automatic cannon and a coaxial light MG. As with later German tanks, all had transceivers, which made them useful as reconnaissance vehicles even after their utility as tanks had ended in 1940.

PzKw IIF light tank



	Weight (tonnes)	8.9	Front Armor (mm)	15
	Length (m)	4.81	Side Armor (mm)	15
	Width (m)	2.22	Engine HP	140
	Height (m)	1.99	Road Speed (km/h)	40

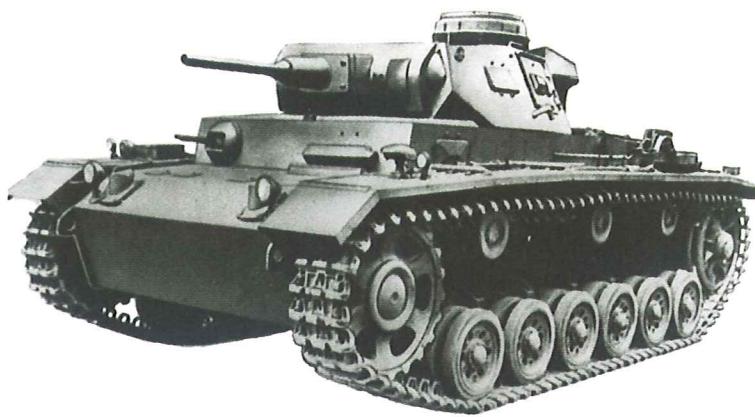


PzKw III Tank (SdKfz 141)

The first four models were produced only in small quantities by Daimler-Benz as trials and training machines: the Model A (10 vehicles), Model B (15), Model C (15) and Model D (30). Most of the development effort was devoted to the suspension, and each had a different running gear system as the manufacturer attempted to optimize the design. The definitive suspension was introduced on the first full-production version, the Model E, for which two additional manufacturers (Henschel and MAN) were brought into the program, although only 96 vehicles were built.

The PzKw IIIE was armed with a 37mm KwK L/46.5 gun with a coaxial MG in a hand-cranked turret, and a second MG in a forward hull mount. Ammunition stowage was 131 rounds of 37mm and 4,500 MG rounds. The vehicle introduced the efficient five-man crew, three of whom were in turret. The Maybach engine gave a good power-to-weight ratio that, combined with the torsion-bar suspension, made the tank fairly quick and agile. The two weaknesses of the tank were the complex transmission (10 speeds forward, 4 reverse) and the thin armor, only 30mm on the front, almost vertical. The PzKw IIIF was essentially identical to the IIIE, but with two more producers (Alkett and FAMO) brought in to help bring the number built to 435 between September 1939 and July 1940. The Es and Fs were subsequently retrofitted with 30mm armor plates welded to the hull front, and some were refitted with the 50mm L/42 gun starting in March 1941.

The PzKw IIIG was initially produced with the 37mm gun, but the 50mm KwK L/42 was cut into production in June 1940 and the last 37mm-armed tank was delivered in August. These still had the 30mm frontal armor and some were retrofitted with an additional plate as in the Es and Fs. The 308 Model Hs were similar, but featured the additional armor from production and a simpler transmission. The Model J had 50mm thick frontal armor built in and the last 1,067 of the 2,616 built used the longer 5cm KwK L/60 gun, which reduced ammunition stowage from 99 to 84. From April 1942 20mm armor was added to the turret front to bring it up to 50mm. The Models L and M were identical to the late-production Model J, but with 57mm thick turret front armor. The Model N was the PzKw IIIM with a 75mm L/24 gun in place of the 50mm.



Above: PzKw IIIF medium tank with 37mm gun (PMK)



Above: PzKw IIIJ medium tank with 50mm gun (PMK)



Above: PzKw IIIN medium tank with short 75mm gun

	PzKw III F	PzKw III J	PzKw III N
Weight (tonnes)	19.8	21.5	23.0
Length (m)	5.38	5.52	5.65
Width (m)	2.91	2.95	2.95
Height (m)	2.44	2.50	2.50
Front Armor (mm)	30	50	57
Side Armor (mm)	30	30	30
Engine HP	300	300	300
Road Speed (km/h)	40	40	40



PzKw IV Tank (SdKfz 161)

The PzKw IV may be regarded as one of the most successful tanks of the war, seeing action as a credible threat on the battlefield from the first day of Germany's war to the last as a result of continual improvements. They were only slightly larger than the PzKw III, with the same armor thickness and engine, but never used the complex 10-speed transmission and employed a leaf-spring suspension that was easier to repair but slightly less effective at smoothing out rough terrain. The main operational difference was in the armament: a short-barrel 75mm KwK37 L/24 gun with a coaxial MG and a second MG in the hull front. Designed for the close support role, the PzKw IV carried 80 rounds for its main gun, mostly HE and smoke.

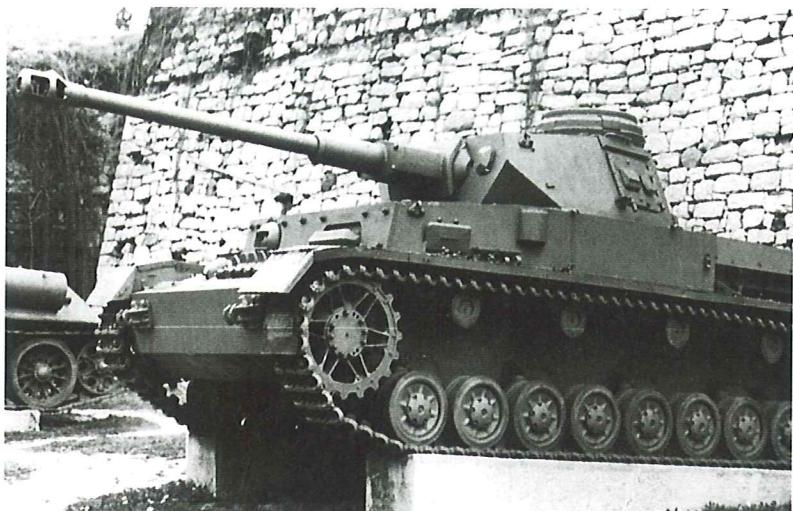
The 35 PzKw IVA were trials vehicles that served in the Polish and French campaigns before being removed from service. The 42 PzKw IVB and 134 PzKw IVC had frontal armor thickness increased from 15mm to 30mm and no hull MG. The PzKw IVD (229 built in October 1939 to May 1941) reintroduced the hull MG and increased the thickness of the side armor from 15mm to 20mm. The Model E (223 built September 1940 to April 1941) had thicker (50mm) armor on the lower hull front, and an added 30mm plate bolted to the superstructure front, the plate also being found on some late-production Model D. The PzKw IVF (426 built April 1941 to March 1942) provided uniform 50mm thick frontal armor (hull, superstructure and turret) as a production feature.

The major change in the PzKw IV came with the Model F2 which incorporated the long-barrel 7.5cm KwK40 L/43 gun. This tank, which the British dubbed the "Mark IV Special", introduced a new level of lethality to the Panzerwaffe. This was quickly succeeded by the PzKw IVG, armed with the L/48 gun, which was subjected to a series of incremental improvements, including supplemental 30mm armor plates on the hull and superstructure front and the addition of "skirts" around the turret and along the sides in March 1943. The Model H (3,774 built to July 1944) was similar to the Model G, but incorporated 80mm thick hull and superstructure armor and an AA mount for an MG on the commander's cupola. The final version was the PzKw IVJ, which differed from the Model H mainly in the deletion of the electric turret traverse in favor of additional fuel stowage.

	PzKw IV D	PzKw IV G	PzKw IV H
Weight (tonnes)	20.0	23.5	25.0
Length (m)	5.92	6.62	7.02
Width (m)	2.84	2.88	2.88
Height (m)	2.68	2.68	2.68
Front Armor (mm)	30	50	80
Side Armor (mm)	20	30	30
Engine HP	300	300	300
Road Speed (km/h)	40	40	49



Above: PzKw IV with short 75mm gun (PMK)



Above: PzKw IV with long 75mm gun (PMK)



Above: PzKw IVH (PMK)



PzKw V Panther

The Panther was produced successively in three variants the first of which, confusingly, was the Model D. As with all the variants, the turret armament consisted of the very powerful 75mm KwK42 L/70 gun and a coaxial MG34. Ammunition stowage comprised 79 rounds of 75mm and 5,100 rounds of 7.92mm. An armored flap covered a direct-vision opening for the driver, while a second, smaller, flap covered an opening through which a bow machine gun could be fired by the bow gunner/radio operator. The suspension consisted of eight pairs of large, interleaved roadwheels sprung on torsion bars, a rear idler and a front sprocket.

Starting with vehicle 851, production shifted to the Model A, which featured an improved commander's cupola and strengthened suspension components, along with reliability improvements. This model also introduced a ball mount on the hull front for the bow machine gun, replacing the earlier flap-and-port arrangement.

After 2,000 Panther As, the production lines again switched, this time to the Panther G. This introduced a number of detail improvements, the most noticeable being the elimination of the driver's vision opening in the hull front. Instead, the driver was supplied with a rotating periscope and seat and control extensions that permitted him to drive with his head out of the hatch. Other changes included upper hull side plates that were 10mm thicker and a variety of reliability improvements. Late-production models used a redesigned gun mantlet that eliminated a shot trap at the base.

Aside from reliability problems, many of which had been ironed out with the Model G, the Panther was probably the best all-around tank of World War II. The gun was powerful and accurate, the armor well-sloped, and mobility about average. Weak points included the final drive unit, short engine life, slow turret traverse and the lack of a periscope for the gunner that slowed engagement time.



First column PzKw V D,
Second column PzKw V A.
Third Column PzKw V G

	43.0	44.8	45.5
Weight (tonnes)	43.0	44.8	45.5
Length (m)	8.86	8.86	8.86
Width (m)	3.40	3.42	3.40
Height (m)	2.95	2.98	2.98
Front Armor (mm)	100	110	110
Side Armor (mm)	45	45	50
Engine HP	700	700	700
Road Speed (km/h)	46	46	46

Top: PzKw V Panther D (PMK)
Middle: PzKw V Panther A (PMK)
Bottom: PzKw V Panther G (PMK)



PzKw VI Tiger

The initial model, the PzKw VI Ausf. E used a suspension similar to that of the Panther, with eight pairs of larger, interleaved road wheels with double torsion-bar suspension, sprocket at the front and idler at the rear. The hull extended out over the tracks in order to permit the installation of a wide ring that accommodated the horseshoe-shaped turret. The turret mounted the 88mm KwK36 L/56 gun and a coaxial MG34, with 92 rounds for the former being accommodated. Early vehicles proved underpowered and in May 1943, starting with vehicle 425, the 600-hp engine was replaced with the 700-hp unit used in the Panther. A series of other detail improvements were also made during the production run, including the addition of an escape hatch in the right side of the turret, and the replacement of the commander's cupola with vision slots by one with periscopes. Eighty-four Tiger Is were completed as command vehicles, with main gun ammunition stowage reduced to 66 rounds to make room for additional radio sets.

The PzKw VI Ausf B (also known as Tiger II and Königstiger) represented an almost complete redesign of the vehicle. The hull adopted the general shape of the Panther, with sloped front and side plates and this, combined with the much greater armor thickness, made it almost invulnerable to Allied tank weapons. The hull was made longer, necessitating an extra pair of road wheels each side. The turret was made narrower and mounted the more powerful 88mm KwK43 L/71 gun (for which 72 rounds were carried) along with the coaxial MG34. A second machine gun was ball-mounted in the hull front for use by the radio operator.

The Tiger I was a fearsome weapon on the battlefield, and the Tiger II almost invincible. Mechanical unreliability, however, reduced its effectiveness and the Tiger II was underpowered, using the same engine as its predecessor.

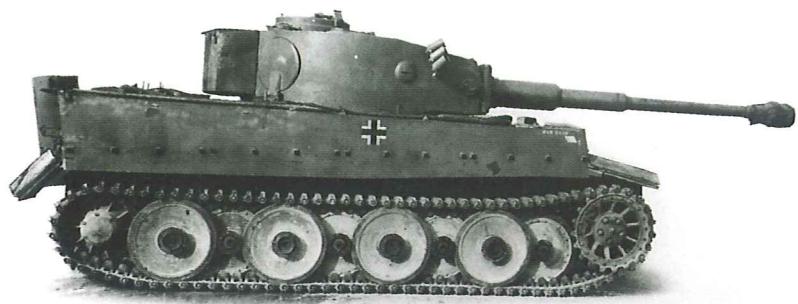
First column PzKw VI E,
Second column PzKw VI B

	Weight (tonnes)	57.0	68.0
Length (m)	8.45	10.3	
Width (m)	3.70	3.76	
Height (m)	2.93	3.08	
Front Armor (mm)	100	180	
Side Armor (mm)	80	80	
Engine HP	650	700	
Road Speed (km/h)	38	35	

Top: PzKw VI E Tiger I (PMK)

Middle: PzKw VI E Tiger I

Bottom: PzKw VI B Tiger II





Sturmgeschütz 7.5cm (SdKfz 142)

This, the original member of the prolific assault gun family, used the chassis of the PzKw III with an armored superstructure to mount the short barrel 75mm StuK37 L/24 gun with 12° traverse each side and elevation of -10° to +20°. The Model A used the chassis and automotive components of the PzKw IIIF. The Model B used a different transmission and a modified engine. In the Model C the gunner's telescope, considered a weak point, was replaced by a periscopic sight projecting through the roof. The Model D added a pannier on the left side for radio equipment. The Model E was intended as a battery commander's vehicle with an additional pannier on the right for radios and provision for optical equipment. The Model E also carried (but did not mount) a light MG. The SdKfz 142 proved a very useful vehicle in 1940/41 but was hampered thereafter by its limited anti-tank potential.

SdKfz 142 Sturmgeschütz



	Weight (tonnes)	20.2	Front Armor (mm)	50
	Length (m)	5.40	Side Armor (mm)	30
	Width (m)	2.93	Engine HP	300
	Height (m)	1.98	Road Speed (km/h)	40

Sturmgeschütz 40 (SdKfz 142/1)

The initial version of this vehicle, the Model F, simply took the previous Model E and replaced the gun with the more powerful L/43 or L/48 gun. The comprehensive revision came with the Model G, which switched to the lower hull of the PzKw IIIJ. Those produced from July 1942 to June 1944 had 30mm supplemental armor attached to the front, after that the base armor was increased to 80mm. The gun had a traverse of 10° each side of center, elevation of -6° to +20°, and was provided with 54 rounds of ammunition. Starting in early 1943 an external MG with shield was provided at the loader's hatch and this was retrofitted to earlier vehicles. This was later replaced by a remote -control mounting. A coaxial MG was fitted starting in early 1944. Armored skirts were usually fitted in the field. The Sturmhaubitze 42 was simply the Model G with a 105mm howitzer replacing the 75mm gun.



	Weight (tonnes)	23.9	Front Armor (mm)	80
	Length (m)	6.77	Side Armor (mm)	30
	Width (m)	2.95	Engine HP	300
	Height (m)	2.16	Road Speed (km/h)	40

StuG IIIF (PMK)



Sturmgeschütz IV (SdKfz 167)

This vehicle was essentially the superstructure (including armament) of the StuG 40 Model G placed on the hull of the PzKw IV. The same changes as were made to the StuG 40 were also applied to the StuG IV, including remote-control machine gun. The only change of note to the superstructure was that the driver's position was moved forward into a protruding cab. On some vehicles a 15cm thick concrete slab provided additional protection to the cab front. This opened up some room in the fighting compartment that allowed ammunition stowage to be increased to 87 rounds. Although the StuG IV had the same main armament as the tank and in a restricted traverse mounting, the low profile made it sufficiently valuable that in January 1944 the Krupp works switched completely from the PzKw IV to the StuG IV.

A destroyed StuG IV being inspected by a GI



	Weight (tonnes)	23.0	Front Armor (mm)	80
	Length (m)	6.70	Side Armor (mm)	30
	Width (m)	2.95	Engine HP	300
	Height (m)	2.20	Road Speed (km/h)	38

Sturmgeschütz 8.8cm Pak43/2 (SdKfz 184) (Ferdinand/Elefant)

The StuG 8.8cm took the unsuccessful Porsche entry from the Tiger development and fitted it with a heavily-armored superstructure, into the front of which was mounted an 8.8cm Pak43/2 (L/71) gun. The gun had a traverse of 14° each side and could elevate from -8° to +14°. Fifty rounds were carried for the gun. No secondary armament was initially fitted, but when the surviving 48 vehicles were pulled out of service in late 1943 for overhaul they were given a ball mount MG in the front, along with a commander's cupola. Extremely well-armed and provided with thick armor, the vehicle was nevertheless a mixed blessing as it used completely non-standard parts, including the troublesome electric drive, of the Tiger(P) and proved underpowered and unreliable. It also had large blind spots to the sides and rear that permitted Soviet infantry to close with the vehicle during the Kursk battle.

SdKfz 184 Elefant



	Weight (tonnes)	65.0	Front Armor (mm)	200
	Length (m)	8.14	Side Armor (mm)	80
	Width (m)	3.38	Engine HP	600
	Height (m)	2.97	Road Speed (km/h)	30



Jagdpanzer IV (SdKfz 162)

This was an evolutionary development of the StuG IV and used the same chassis, that of the PzKw IVF tank. The main change was to the superstructure, which was brought forward and given a completely sloping front face. The main gun remained the same, a 7.5cm Pak39 (L/48) with 79 rounds of ammunition. The gun traversed 20° total and elevated from -5° to +15°. Two machine gun ports were initially provided in the hull front, reduced to one from May 1944. At the same time, the armor thickness was increased, to 80mm at the front and 40mm at the sides. Muzzle brakes were originally fitted, but often removed in the field because of the dust they kicked up, and were not installed in later vehicles. A command version, identical to the basic model but fitted with an additional radio, was also built.

Jagdpanzer IV



	Weight (tonnes)	24.5	Front Armor (mm)	60
	Length (m)	6.85	Side Armor (mm)	30
	Width (m)	3.17	Engine HP	300
	Height (m)	1.85	Road Speed (km/h)	40

Jagdpanzer IV/70

There were actually two versions of this vehicle in production simultaneously, the Jagdpanzer IV/70(A) built by Alkett, and the Jagdpanzer IV/70(V) by Vomag. The two were very similar, the main difference being the addition of a vertical portion on the lower part of the upper hull on the (A) model. The Alkett design was easier to manufacture, but was 0.5 meters higher and 2.5 tons heavier. The main gun was the 75mm Pak42 L/70 as used in the Panther, with a traverse of 12° each side of center and elevation of -5° to +15°. The (V) model carried 60 rounds of ammunition and the (A) model 90 rounds. The Panzer IV/70 was nose-heavy as a result of the long gun barrel, and the first two road wheels on each side were fitted with steel rims to prevent disintegration of the rubber wheels.



	Weight (tonnes)	25.8	Front Armor (mm)	80
	Length (m)	8.50	Side Armor (mm)	40
	Width (m)	3.17	Engine HP	300
	Height (m)	1.85	Road Speed (km/h)	35

Jagdpanzer IV/70(V)



Jagdpanther (SdKfz 173)

In this vehicle, the upper hull was extended upward to create a sloped box superstructure into which the powerful gun could be mounted. The main armament was the 8.8cm Pak43 L/71 with a traverse of 13° each side and elevation of -8° to +15°, and for which 57 rounds were carried. A light MG was carried in a hull mount on the superstructure front, along with a 90mm NbK 39 close defense weapon on the roof. A few changes were made during the production run, reducing the number of driver's vision slots from two to one, and from a small welded gun mount, to a larger bolted one. The Jagdpanther was mobile, admirably protected by thick, well-sloped armor and possessed of a powerful, accurate gun. Within the inherent limitations of the non-turreted design, the Jagdpanther was the most successful and best-balanced tank killer of the war.

Jagdpanther (PMK)



	Weight (tonnes)	46.0	Front Armor (mm)	80
Length (m)	9.90	Side Armor (mm)	50	
Width (m)	3.42	Engine HP	700	
Height (m)	2.72	Road Speed (km/h)	46	

Jagdtiger (SdKfz 186)

The heaviest AFV to see combat during the war, the Jagdtiger used a lengthened version of the Tiger II chassis fitted with a large, massively-armored box superstructure. Armament consisted of the 12.8cm Pak44 L/55 gun and a bow-mounted machine gun. The main gun had a traverse of 10° each side of center and an elevation of -7.5° to +15° and was provided with 40 rounds of ammunition. The vehicle had a crew of six, two loaders being necessary to handle the heavy ammunition. Certainly a fearsome weapon, it is not clear what advantages were purchased with the diversion of resources from the Tiger II program. The long-barrel 88mm on the Tiger II was capable of dealing with any tank it met on the battlefield at all ranges at which it could expect to get a hit. The 12.8cm gun gave longer ranges but, lacking range-finding equipment, getting a hit at extended ranges was mostly a matter of luck.

SdKfz 186 Jagdtiger



	Weight (tonnes)	70	Front Armor (mm)	250
Length (m)	10.65	Side Armor (mm)	80	
Width (m)	3.63	Engine HP	700	
Height (m)	2.95	Road Speed (km/h)	38	



Sturmpanzer IV (SdKfz 166) (Brummbär)

The 15cm heavy infantry gun (sIG) was a very effective close support weapon, but it took a while to come up with the proper armored assault carrier. The final answer was the Brummbär, which mated the sIG with the PzKw IV chassis in a large, built-up superstructure. The weapon had a traverse of 10° each side of center and an elevation range of -7° to +20°. Despite the boxy upper portion, the vehicle was actually quite cramped and could only carry 38 rounds of the large ammunition. Starting in June 1944 vehicles were produced with a ball-mounted MG on the front face and a commander's cupola with an AA MG mount. At the same time, the mount was redesigned, a lightened version of the gun installed, and the height reduced slightly.



Early production Brummbär without MG on front face



Weight (tonnes)	28.2	Front Armor (mm)	100
Length (m)	5.93	Side Armor (mm)	50
Width (m)	2.88	Engine HP	300
Height (m)	2.52	Road Speed (km/h)	40

4.7cm Pak(t) auf PzKw IB

This was the first, and simplest, of the conversions to an SP anti-tank vehicle. The main weapon was the captured Czech 47mm Pak, which was provided with a traverse of 17.5° each side of center and an elevation range of -8 to +12°. A fixed shield was provided, but was open at the back and top. No secondary armament was provided. A total of 86 rounds of 47mm were carried. The gun was powerful and effective for its time and the Pz IB chassis provided adequate mobility, but the crew of three (only two of whom were on the gun) was somewhat inefficient. The vehicle served in all theaters and remained in service in diminishing numbers (and with decreasing effectiveness) until 1943.



Weight (tonnes)	6.4	Front Armor (mm)	13
Length (m)	4.42	Side Armor (mm)	13
Width (m)	2.06	Engine HP	100
Height (m)	2.25	Road Speed (km/h)	40

4.7cm(t) auf PzKw IB



7.5cm Pak40 auf PzKw II (SdKfz 131)(Marder II)

This vehicle took the chassis of the PzKw IIF and extended the superstructure to create a fighting compartment in the center and rear. Into that was placed the upper half of the field carriage mount for the 75mm Pak40, mounted on supporting girders. The gun had a traverse range of 32° left and 25° right of center and could elevate from -8° to +10°. A light MG was usually carried, but could be pintle-mounted for AA defense, and 37 rounds of 75mm ammunition was carried. The SdKfz 132 was almost identical, but used the PzKw IID chassis and mounted the 7.62cm Pak36r gun, and was a conversion rather than a new-build. Both were tall vehicles and left the crew exposed to lateral and rear fire, but their armament was good and they were useful expedients until the dedicated tank destroyers came into service, although they were never completely replaced.

SdKfz 131 Marder II



	Weight (tonnes)	10.8	Front Armor (mm)	30
	Length (m)	6.36	Side Armor (mm)	15
	Width (m)	2.28	Engine HP	140
	Height (m)	2.20	Road Speed (km/h)	40

8.8cm Pak43 auf PzKw III/IV (Hornisse)(Nashorn)

This was the final open-topped self-propelled anti-tank gun and represented the pinnacle of its development. The chassis was based on the PzKw IV and borrowed heavily from the 15cm SP howitzer Hummel. The main weapon was the much-feared 88mm Pak43 L/71 gun, which was provided with a traverse of 30° total and an elevation of -5° to +20°. 40 rounds of ammunition were carried. Secondary armament was a single light MG that could be pintle-mounted for AA defense. In February 1944 the name was changed from Hornisse to Nashorn, coincident with some minor production changes. The Hornisse made a large target, was only thinly armored and the limited traverse of the main gun carried tactical disadvantages, but its Pak43 could slice through any enemy tank it met at all practical ranges and it remained in production to war's end.

Nashorn 8.8cm (PMK)



	Weight (tonnes)	24.0	Front Armor (mm)	30
	Length (m)	8.44	Side Armor (mm)	20
	Width (m)	2.86	Engine HP	300
	Height (m)	2.65	Road Speed (km/h)	42



15cm sIG auf PzKw I (Bison)

To create a heavy fire support vehicle quickly, Alkett simply removed the turret and superstructure from 38 excess PzKw IB tanks and built up a large, boxy shield made up of three 10mm-thick armor plates that was open at the rear and top. Into this was placed a 15cm sIG33 heavy infantry gun on field carriage (less wheels). In this mounting the gun had a traverse of 12.5° left and right of center and an elevation range of -4° to +75°. The sIG was certainly an effective weapon, and the provision for high elevation permitted use in the indirect fire mode if required, but the vehicle severely overloaded the chassis, leading to poor mobility. The vehicles were used in the 1940 campaign, and the last was finally lost in 1943.



sIG auf PzKw I Bison

	Weight (tonnes)	8.5	Front Armor (mm)	13
	Length (m)	4.67	Side Armor (mm)	13
	Width (m)	2.06	Engine HP	100
	Height (m)	2.80	Road Speed (km/h)	40

leFH 18/2 auf PzKw II (SdKfz 124) (Wespe)

This vehicle mounted the 105mm light field howitzer on a slightly lengthened PzKw II chassis. The engine was moved forward to the center of the vehicle to create space at the back for the fighting compartment, the sides of which were extended upward. The howitzer could traverse 17° each side of center and elevate from -5° to +42°, and this relatively high elevation for an SP mount gave a range of 10,500 meters. The vehicle carried 32 rounds of ammunition. A light machine gun was carried, but not mounted, on the vehicle for close-in defense. Some vehicles were completed without guns as ammunition carriers to carry 90 rounds. These could be converted to gun vehicles in the field with little trouble if required. The vehicles were effective and popular in all theaters except Italy, where they proved underpowered for operations in mountains.



SdKfz 124 Wespe light SP howitzer

	Weight (tonnes)	11.0	Front Armor (mm)	30
	Length (m)	4.81	Side Armor (mm)	15
	Width (m)	2.28	Engine HP	140
	Height (m)	2.30	Road Speed (km/h)	40



sFH 18/1 auf PzKw III/IV (SdKfz 165) (Hummel)

The standard SP heavy field piece mounted the 15cm sFH 18/1 on a hybrid PzKw III/IV chassis, essentially a PzKw IV lengthened slightly with the engine moved forward to the center. The piece had a traverse of 15° each side of center, while the open bed at the rear allowed an elevation of +42° to yield close to the piece's theoretical maximum range. A light MG was carried, but not mounted, for local defense. The driver and radio operator sat at the front and the gun crew of four at the rear. The Hummel carried only 18 rounds for the howitzer, and a version without the gun but with extra ammunition racks was also built as an ammo carrier to provide two such vehicles to each six-gun battery. The lack of a muzzle brake (eliminated after the prototype) prevented the weapon from firing with uppermost (eighth) charge.

SdKfz 165 Hummel heavy SP howitzer

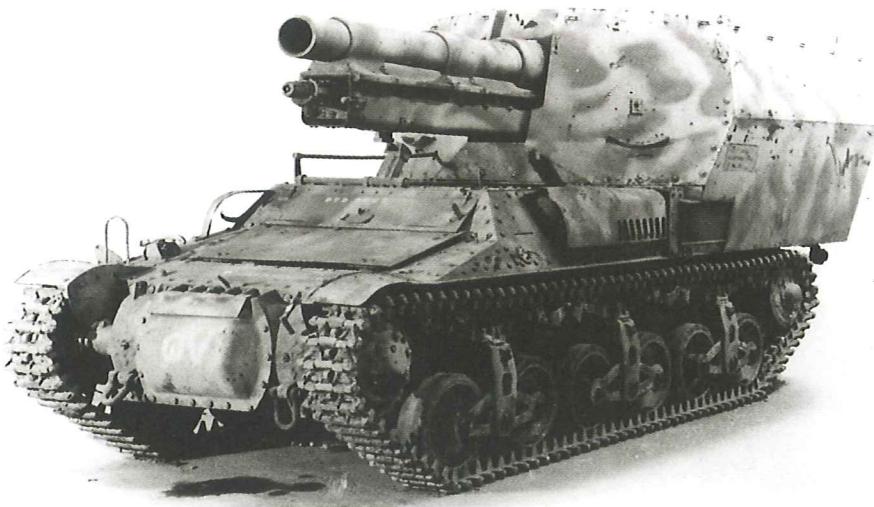


	Weight (tonnes)	24.0	Front Armor (mm)	30
	Length (m)	7.17	Side Armor (mm)	20
	Width (m)	2.97	Engine HP	300
	Height (m)	2.81	Road Speed (km/h)	42

sFH 13/1 auf Lorraine Schlepper (SdKfz 135/1)

This was the most common, and successful, of the conversions of French chassis into SP artillery. Because of the open rear compartment the Lorraine was a good basis for conversions and 94 were used for the 15cm howitzer, 12 for the 10.5cm howitzer, and 170 for 7.5cm Pak, all using a similar configuration. In fact, the only real alterations were the addition of the superstructure sides, the gun, and a recoil spade at the rear (the spade not being present on the anti-tank vehicle). Because of the light weight of the tractor the old 15cm sFH 13 was chosen in lieu of the more powerful sFH 18. It was mounted with 5° of traverse each side and 0 to +40° elevation, but only eight rounds of ammunition could be carried. As mounted in the vehicle, the howitzer had a maximum range of 8,600 meters.

SdKfz 135/1 15cm howitzer on Lorraine chassis



	Weight (tonnes)	8.49	Front Armor (mm)	10
	Length (m)	5.31	Side Armor (mm)	9
	Width (m)	1.83	Engine HP	70
	Height (m)	2.23	Road Speed (km/h)	34



FlakPanzer IV

There were three variants of this vehicle, the earliest and most numerous being the "Mobelwagen", which placed a 3.7cm Flak43 AA gun in a well in the hull of the PzKw IV. Folding panels 20mm thick provided protection against fragments for the crew when not in action, and dropped down to provide a work surface when firing. The lack of protection for the crew when in action was a major drawback. The replacement was the "Wirbelwind", which mounted a quad 20mm in an open-topped octagonal turret with 16mm thick walls. The turret housed a four-man crew (commander, gunner, two loaders). This was a much better solution and the quad-20 was a lethal weapon within its engagement envelope, but a longer range was desired, leading to the third variant, the "Ostwind". This replaced the quad-20 with a single 37mm Flak43, while reducing the turret crew to three.

Mobelwagen with sides dropped for action (PMK)



	Weight (tonnes)	24.0	Front Armor (mm)	80
	Length (m)	5.92	Side Armor (mm)	30
	Width (m)	2.95	Engine HP	300
	Height (m)	2.73	Road Speed (km/h)	38

Light Armored Car Family (SdKfz.221/222/223/260/261)

There were three basic family members that entered production in 1935-36, all based on the Horch 801 4x4 chassis. The SdKfz.221 had a crew of two and was fitted with an open-topped turret with a single MG and a short-range radio. The SdKfz.222 was the 221 but with a larger turret with a 2cm autocannon, a coaxial MG and a three-man crew. The SdKfz.223 was similar to the 221, but moved the turret slightly to the rear to accommodate a long-range radio and a third crewman. The same chassis and body were used to create the SdKfz.260 and 261 radio cars, which dispensed with all armament in favor of long-range radios and frame antennas. With thin armor (proof only against non-AP small arms fire) and weak armament, the initial members of the family were phased out of production, the last 222 being in built in June 1943 and the last 223 in January 1944.

SdKfz 222 light armored car



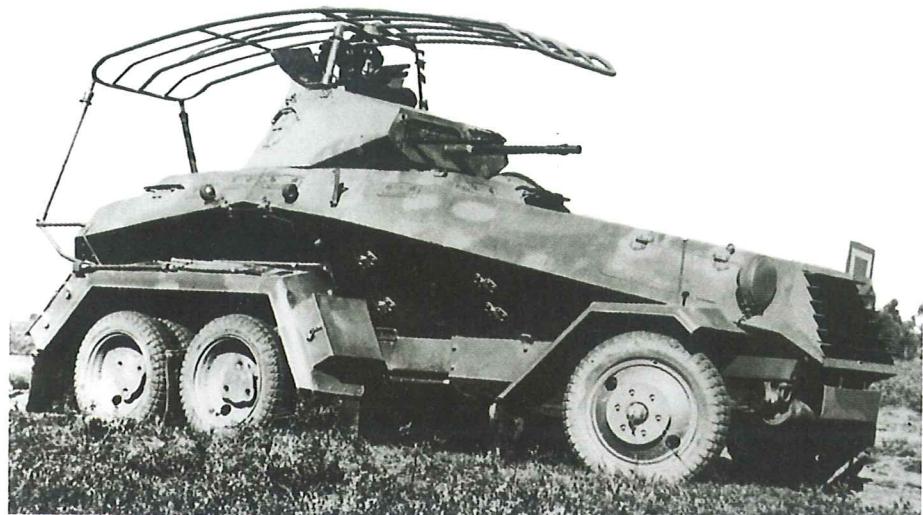
	Weight (tonnes)	4.8	Front Armor (mm)	8
	Length (m)	4.80	Side Armor (mm)	8
	Width (m)	1.95	Engine HP	75 or 90
	Height (m)	2.00	Road Speed (km/h)	85



Heavy Armored Car SdKfz 231/232/ 263 (6-rad)

The first of the new German armored cars, these were built on 6x4 truck chassis strengthened to take the additional weight. The armament of the SdKfz 231 and 232 (6-rad) was a 2cm KwK30 cannon and a coaxial MG13 in the turret, with elevation of -12° to $+20^{\circ}$. The SdKfz 263 had a fixed casemate with a single MG13 instead of a turret. The SdKfz 232 had a large frame antenna, while the SdKfz 263 had the frame antenna and a telescoping mast antenna. The first two were used by reconnaissance troops and the SdKfz 263 by signal troops. The crew consisted of four, including front and rear drivers. They were withdrawn from frontline service in 1940 because of their poor off-road mobility and the large size combined with thin armor.

SdKfz 232 armored car



	Weight (tonnes)	5.35	Front Armor (mm)	8
	Length (m)	5.57	Side Armor (mm)	8
	Width (m)	1.82	Engine HP	65
	Height (m)	2.25	Road Speed (km/h)	70

Heavy Armored Car Family (SdKfz.231 (8-rad)/232 (8-rad)/233 (8-rad))

These large vehicles used a Büssing-NAG chassis with power and steering to all eight wheels. Front and rear driving positions were provided for quick withdrawal. The SdKfz 231 and 232 were armed with a 20mm KwK and a coaxial light machine gun in a turret and carried 180 rounds for the main gun, which could elevate from -1° to $+26^{\circ}$. The difference between the two was that the SdKfz 232 was fitted with an additional, long-range, radio and frame antenna above the turret. Early production models had 15mm thick frontal armor, and from early 1940 an additional 8mm plate was added to the front. Starting in May 1942 hull frontal armor thickness was increased to 30mm. A special radio version without the turret, the SdKfz.263, entered production in 1938. A fire support vehicle in which the turret was replaced by a 7.5cm StuK37 L/24 gun with 12° traverse each side was introduced in late 1942.

SdKfz 231 (8-rad)



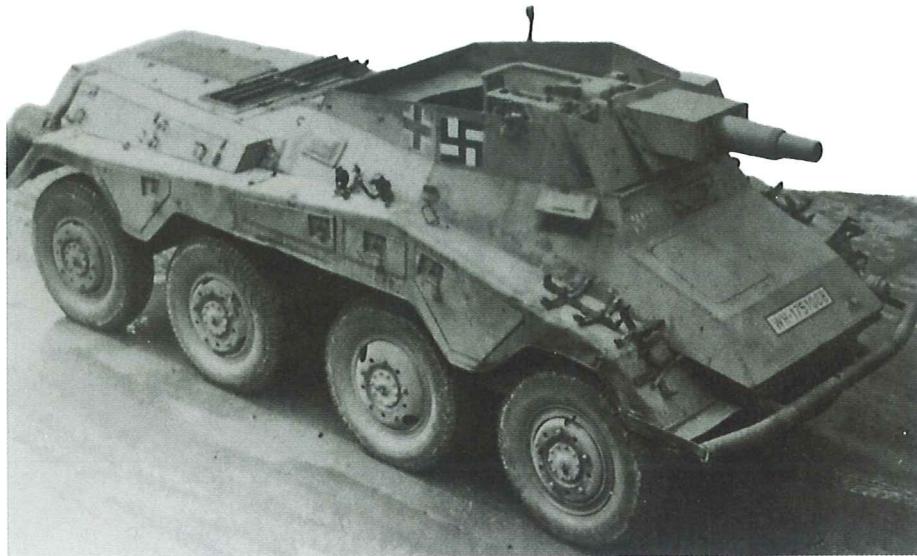
	Weight (tonnes)	8.3	Front Armor (mm)	15
	Length (m)	5.85	Side Armor (mm)	8
	Width (m)	2.20	Engine HP	150
	Height (m)	2.35	Road Speed (km/h)	85



Heavy Armored Car SdKfz 234

The SdKfz 234 chassis was developed in four variants, differing in their armament. The SdKfz 234/1 used an open-topped turret with 2cm KwK38 and coaxial MG42. The SdKfz 234/2 "Puma" featured a rounded closed turret with the 5cm KwK39 L/60 gun and coaxial MG42. The SdKfz 234/3 dispensed with the turret in favor of a low, open superstructure with the 7.5cm L/24 gun with a traverse of 12° each side. The SdKfz 234/4 was similar to the 234/3, but was fitted with the 7.5cm Pak 40 L/46 anti-tank gun. The cars carried 480 rounds of 2cm, 55 rounds of 5cm, 50 rounds of short 7.5cm or 12 rounds of long 7.5cm ammunition. Although large, the vehicles had excellent cross-country mobility and firepower. By the time they came into service, however, the need for such vehicles in the German Army had decreased dramatically.

SdKfz 234/3 armored car with short 7.5cm gun



	Weight (tonnes)	11.5	Front Armor (mm)	30
Length (m)	6.00	Side Armor (mm)	8	
Width (m)	2.40	Engine HP	220	
Height (m)	2.10	Road Speed (km/h)	80	

Light Armored Half-Track SdKfz 250

The smaller of the two armored half-track families was built in a wide variety of configurations for general and specialized applications. The only major change to the basic vehicle during its production run was the replacement of the multi-angled open-topped body with one with fewer (albeit larger) plates to simplify production. The chassis was that of the Demag D7 half-track, shortened and with one wheel and torsion bar removed per side. The front axle was unpowered.

The variants included the basic half-section infantry carrier ((SdKfz 250/1), with room for four passengers), a wire-laying vehicle (250/2), radio vehicle (250/3), observation vehicle for assault gun units (250/4 and 250/5), a carrier for 70 rounds of short or 60 rounds of long 7.5cm ammunition for assault guns (250/6), 81mm mortar carrier with 42 rounds (250/7), fitted with 7.5cm L/24 gun firing forward and 20 rounds of ammunition (250/8), with 2cm/light MG turret fitted for reconnaissance



	Weight (tonnes)	5.8	Front Armor (mm)	14
Length (m)	4.56	Side Armor (mm)	8	
Width (m)	1.95	Engine HP	100	
Height (m)	1.66	Road Speed (km/h)	60	

SdKfz 250/1 basic half-group carrier



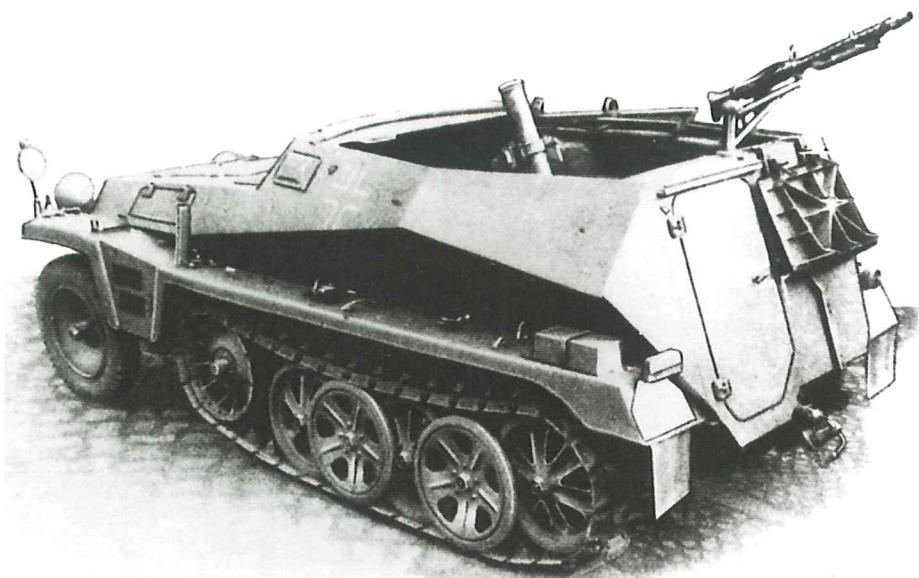
Light Armored Half-Track SdKfz 250 (continued)

role (250/9), with 3.7cm Pak pindle-mounted forward with 216 rounds (250/10), with 2.8cm sPzB gun pindle-mounted forward (250/11), and artillery survey and range-finding vehicle (250/12). Two more specialized versions with fully-enclosed bodies were also developed early on to support the assault guns: the SdKfz 252 ammunition carrier and the SdKfz 253 observation vehicle. A number of improvised variants were also fielded, including those mounting captured French 25mm AT guns and 5cm Pak.

Although useful, they lacked the flexibility of the larger SdKfz 251 chassis and their production tailed off later in the war in favor of the latter.

Right: SdKfz 250/7 81mm mortar carrier

Below: SdKfz 250/9 half-track armored car (PMK)



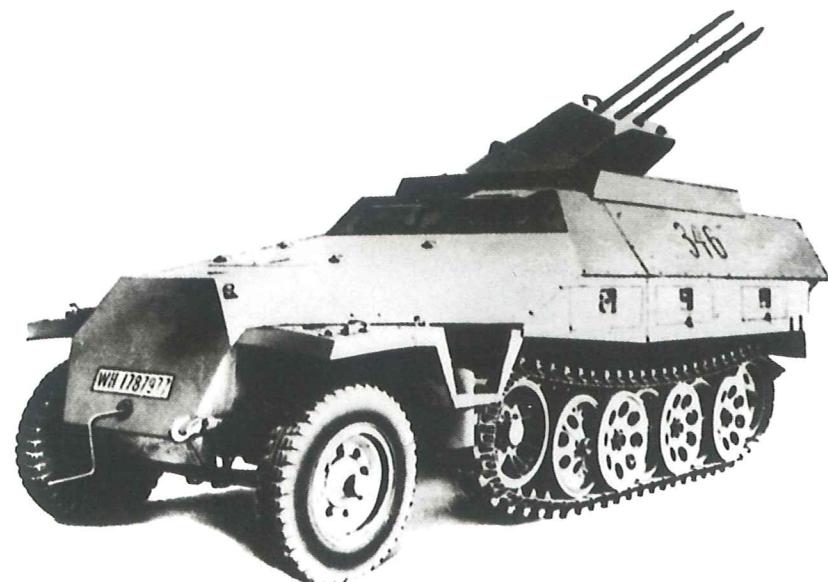
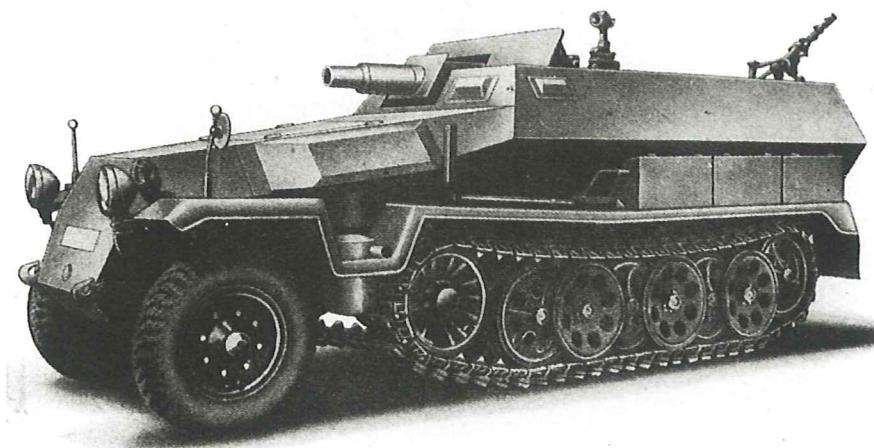


Medium Armored Half-Track SdKfz 251

The larger half-track series was built on the chassis of the Kfz.11 3-ton tractor. The first three models (A, B & C) used a complex but well-shaped open-topped hull that could carry the driver, commander and ten passengers in its basic APC configuration. The Model D, introduced in 1943, simplified the hull design to reduce the number of armor sheets required and cut manufacturing time.

Due to the larger size of the rear compartment it was amenable to modification to a wide variety of roles. The main ones were: APC (SdKfz 251/1), 81mm mortar carrier with 66 rounds (251/2), radio vehicle (251/3), as a tractor for the 7.5cm leG infantry gun (251/4), a pioneer squad vehicle (251/5), command post vehicle (251/6), heavy pioneer equipment carrier (251/7), armored ambulance (251/8), mounting the 7.5cm L/24 gun firing forward with 52 rounds (251/9), mounting the 3.7cm Pak on a pedestal as a platoon commander's vehicle (251/10), wire-laying vehicle (251/11), artillery survey vehicle (251/12), artillery sound-locating vehicle (251/13 and 251/14), artillery flash-spotting vehicle (251/15), flame-thrower vehicle (251/16), with 2cm Flak on AA mount (251/17), artillery observation (251/18), telephone switchboard vehicle (251/19), infra-red searchlight vehicle (251/20), with triple mount 1.5cm or 2cm MG151 cannon (251/21), carrying a 7.5cm Pak40 anti-tank gun (251/22), with a 2cm gun and coaxial MG in an open turret (251/23).

The SdKfz 251 family proved exceptionally useful throughout the war and remained in production to the end. It was one of only two armored personnel carriers successfully fielded on a large scale during the war, sharing that honor with the US half-track series.



Weight (tonnes)	7.81
Length (m)	5.80
Width (m)	2.10
Height (m)	1.75
Front Armor (mm)	15
Side Armor (mm)	8
Engine HP	100
Road Speed (km/h)	53

Top: Sdkfz 251/1 personnel carrier

Middle: Sdkfz 251/9 with 7.5cm short gun (PMK)

Bottom: Sdkfz 251/21 with Model D body style





Hungary

The Trianon peace treaty of 1920 prohibited Hungary from possessing any tanks and permitted only one company of armored cars for police use. A clandestine effort to develop an armored force began in 1928 and a few examples of several vehicles, including the Carden-Loyd Mk IV machine gun carrier, Fiat 3000B tanks and Vickers-Crossley armored cars were acquired in the early 1930s.

The first significant purchase came in 1934 with a purchase of 25 CV33 tankettes from Italy, followed a year later by a larger purchase of CV35s, permitting the formation of seven tankette companies. In Hungarian service the CV33 became known as the 35M and the CV35 as the 37M Ansaldo light tanks. They were used in the opening phases of Operation Barbarossa, but were quickly found to be so tactically limited that the fact that they broke down almost immediately in the heavy, long-distance operations involved was not considered much of a loss.

In 1937 a comprehensive reorganization of the Army (Honved), known as the Huba I program, was drafted that would result in a clear violation of the treaty. In 1938 Hungary formally renounced the treaty. A key feature was the creation of two motorized brigades each of which, by 1941, would include 13 armored cars and 36 light tanks.

Miklos Straussler had begun designing light tanks and armored cars in the early 1930s and in co-operation with the Weiss Manfred works had produced a prototype V-3 tankette in 1933 and a V-4 light tank in 1936. An alternative to the Straussler design was found in Sweden, where Hungary already, in 1936, had purchased a single L-60 light tank from Landsverk. In 1937 a competitive trial was held between the L-60 and the V-4. Landsverk was producing some of the most advanced tanks in the world in the early 1930s and although this lead had largely evaporated by the middle of the decade, their products were still respectable and it is not surprising that they won the competition. Nevertheless, some reservations were expressed about the L-60, including its thin armor, rough-riding suspension and inefficient transmission. Some of these problems were quickly solved, but others could not be rectified in the time available.

A production license was acquired from Landsverk and the tank was designated the 38M Toldi A20. Several armament options were considered, including 37mm and 40mm guns, but those would have required a complete redesign of the turret, so the 20mm 36M anti-tank rifle was chosen. Once that decision was made the firms of MAVAG and Ganz were





JANE'S TANKS OF WORLD WAR II

set to work to build the first 80 tanks, using some components imported from Sweden and Germany to speed the effort. Production got off to a slow start, however, and the first two were not delivered until February 1940. By September of 1940 only 45 had been delivered but, as production ramped up additional orders covering 42 from MAVAG and 68 from Ganz were placed as the 38M Toldi II B20. These differed from the original models only in detail, and both proved unreliable when subjected to the stresses of the long distances involved on the Eastern Front starting in mid-1941.

Further problems became apparent by the end of 1941. A review of operations up to November 1941, when the Hungarian Mobile Corps was returned from the front, indicated that the Toldi's 20mm gun was completely inadequate and the armor too thin. The major obstacle to regunning the Toldi was the need to

completely redesign the turret. Once this was accomplished a two-fold effort was launched; on the one hand Ganz was directed to build 12 of the new tanks, known as the 38M Toldi III C40, and to rebuild 40 Toldi I and 40 Toldi II to the new standard with the designation 38M Toldi IIa B40. The new-build contract was cancelled as it had been decided not to build any more light tanks, but the conversion program was allowed to proceed.

The need for a medium tank had been foreseen before the war and in 1939 contacts were established with four organizations. MAVAG and Ganz began negotiations with Landsverk for the license production of its Lago tank, but development was delayed and before a prototype was available a selection had been made. The Honved asked Germany about license-building some of their tanks in April 1939 but received no answer. A repetition of the

Below: Hungarian L3s before the start of Operation Barbarossa.

query in December 1939 was met with a refusal. Italy offered the M11/39, but the Hungarians were not that desperate. They did show some interest in the M13/40, but once again another vehicle had been selected by the time a sample vehicle was made available. The tank selected was the T-21 from Skoda, a prototype of which arrived in June 1940. Testing was completed in July and a license agreement for the tank and the 40mm A17 gun was signed in August.

Modifications were made to the design, now known as the 40M Turan, and production contracts were awarded to four firms: WM and Raba for 70 each for delivery starting in August 1941, Mowag for 40 and Ganz for 50, with delivery starting eight months later due to their involvement in the Toldi program. Production





efforts began on schedule in October 1940, but the first vehicle was not in fact delivered until April 1942 due to design changes.

These tanks were to be used to start the expansion of the two motorized brigades into armored divisions each with 13 armored cars, 124 light tanks and 180 medium tanks, along with 24 SP 40mm.

A revision in the Honved's order of battle (Huba III) resulted in the placing of an order for an additional 215 Turans in August 1941. This, however, was reduced to 207 in August, then again to 124 in May 1942, and then finally to 55 (12 from Raba, 24 from Ganz and 19 from MAVAG) as a result of escalating costs and the desire to move to the more powerful Turan II. In the event, only 49 were delivered, Raba producing only half its share.

In May 1941 the Honved published a specification for a further development of the Turan featuring a short-barrel 75mm gun with a muzzle velocity of 500 m/s and a coaxial 12.7mm machine gun. The heavy MG never completed development and in September the specification was changed to use the 8mm weapons as on the Turan I. A prototype of the new tank, designated the 41M Turan II was successfully tested in April-May 1942. There followed considerable uncertainty about the production program. The initial contract was given to WM for 90 vehicles in July 1941 (with WM's portion of the Turan I production handed over to Ganz and MAVAG). In July the order was increased to 102 and in May 1942 to 205, this time with other producers brought in. The order was modified in February 1943 to 322 tanks, and then again in May as 222 (WM 62 tanks, Rada 68 and Ganz 92). The deteriorating war situation, in particular power blackouts and shortages of materials, delayed deliveries and Ganz delivered only about 50 of their tanks, although the others completed theirs. There was no production after mid-1944.

One of the few areas in which the Honved was in advance of its foreign contemporaries was the provision of mobile anti-aircraft defense. Landsverk had developed the L-62 SP AA vehicle, mating the famous Bofors 40mm gun with the chassis of the L-60 light tank. Since Hungarian licenses had been acquired for both the gun and the vehicle it made sense to

	1939	1940	1941	1942	1943	1944	1945
Production							
Csaba armored car	-	50	32	50	-	-	-
Toldi light tank	-	80	110	-	-	-	-
Turan medium tank	-	-	-	190	65	24	-
Turan II medium tank	-	-	-	-	120	60	-
Nimrod SP	-	-	-	46	71	18	-
Zrinyi assault guns	-	-	-	-	30	36	-
Conversions							
Toldi I & II to Toldi IIa	-	-	-	-	80	-	-
Imports							
TK/TKS	15	-	-	-	-	-	-
Renault R-35	3	-	-	-	-	-	-
Hotchkiss H-35/39	-	-	-	15	-	-	-
Somua S-35	-	-	-	2	-	-	-
LT-35	2	-	-	-	-	-	-
PzKw IB	-	-	-	8	-	-	-
PzKw IIF	-	-	-	6	-	-	-
PzKw 38(t)	-	-	-	108	-	-	-
PzKw IIIM	-	-	-	10	-	10	-
PzKw IVF1	-	-	-	22	-	-	-
PzKw IVF2	-	-	-	10	-	-	-
PzKw IVH	-	-	-	-	-	12	30
PzKw V	-	-	-	-	-	8	-
PzKw VI	-	-	-	-	-	12	-
StuG40	-	-	-	10	-	-	-
StuG40G	-	-	-	-	-	40	-
L-160	-	-	-	-	-	-	-
Marder II	-	-	-	5	-	-	-
Hetzer	-	-	-	-	-	50	50

allocations by year are estimates

Hungarian AFV Deliveries

examine the L-62 as a whole. Trials were held in 1939 and in 1940 an initial order for 46 vehicles (designated the 40M Nimrod) was placed with MAVAG. This was followed by a second batch of 89 ordered in 1941. Originally designed by Landsverk for the air defense role, the Hungarians mainly used them for anti-tank duty, for which their thin armor and marginal gun made them unsuitable. The first Nimrod unit was formed in May 1942 and was variously referred to as an armored gun battalion, an armored autocannon battalion and a tank-hunter battalion, reflecting the disparity of roles envisioned.

The light Nimrod had some utility as a general-purpose support vehicle, due largely to the versatile (if small) Bofors gun, but was really underarmed and too thinly armored to be effective in high-density warfare for long. The success of the German assault guns, however,

had not gone unnoticed. WM's 1942 proposal to the General Staff to create a similar vehicle on a widened version of the Turan chassis was thus met with immediate enthusiasm. Work was carried out quickly and a prototype ran tests in December 1942. The vehicle was accepted as the 40/43M Zrinyi in late January 1943 and a contract for 40 was awarded. The 1st Assault Artillery Battalion was raised in mid-year and completed with 30 vehicles by year's end.

The Zrinyi was popular, being hard-hitting with good mobility and a low profile, but it lacked anti-tank capability. An effort had begun to fit the long-barrel 75mm gun to Zrinyi, in fact, the 75mm version was often known as the Zrinyi I and the howitzer version the Zrinyi II. The assault gun battalions were planned to consist of 21 gun versions and 9 howitzer versions. The gun program met with continual delays, however, and only four production

vehicles were ever built.

In early 1944 WM was commissioned to build a prototype of a tank destroyer mounting a long-barrel 75mm gun on the chassis of the Turan, in much the manner of the German Marder vehicles. This was completed and Ganz was given a contract to build six examples, but it is not clear if they were ever built.

Medium- range reconnaissance for the mobile forces was to be carried out by the Csaba armored car. The only armored vehicle of purely Hungarian origins to see service, the Csaba owed much of its configuration to pioneering efforts of local designer Straussler. An initial order for 61 vehicles was placed with WM in 1939 and they were available for use in the opening phase of Operation Barbarossa. A second order for 32 (including 12 command versions) was placed in 1940. A third order for 50 vehicles (including 27 command vehicles) was placed in 1941 but later cancelled.

With the decision in the late 1930s to license-build armored vehicles, no such vehicles were initially imported. A small number of TK tankettes and R-35 tanks were acquired from retreating Polish forces in 1939, although this was obviously unplanned. The major change came with the decision to prepare an armored division for service on the Eastern Front in 1942. The Turans would not be ready in time, so an armored component had to be purchased from Germany. The Germans had stocks of PzKw 38(t) tanks that were being displaced from their inventory and they sold 108 of these in the spring of 1942, along with 2 PzKw I command tanks and 22 PzKw IVF (short-barrel) to form the tank regiment. In June they sold four more PzKw I command vehicles, and in September ten each of PzKw III, PzKw IVF2 (long-barrel) and StuG 40s. Almost all of these vehicles were lost in the winter battles on the flanks of Stalingrad and when the remnants of

the division returned to Hungary in March 1943 it brought back only three Toldis and three Csabas.

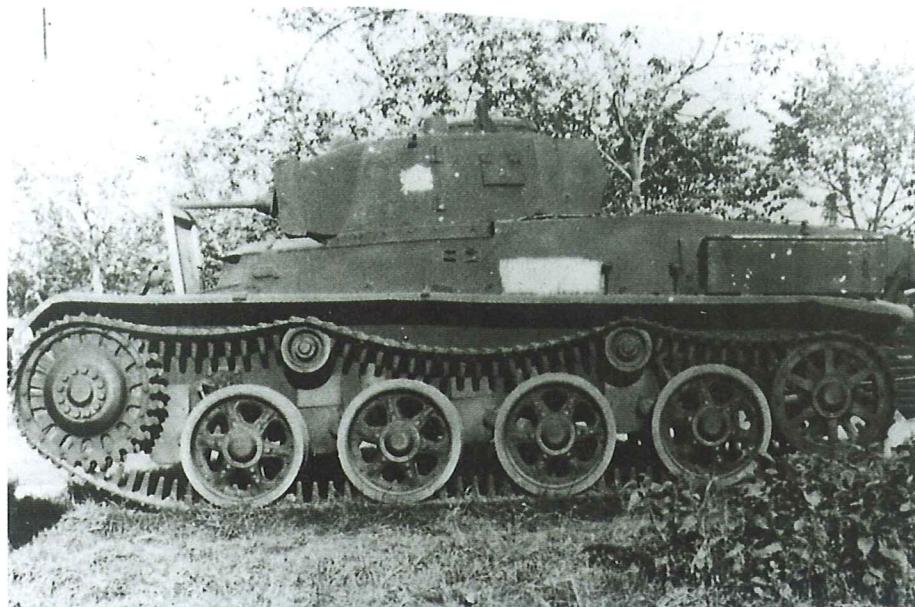
In the meantime, the raising of a second armored division was taking place in Hungary with Turan tanks, although only the Turan II could be considered a useful weapon. To complicate matters, the Germans occupied Hungary in March 1944, after which Hungarian AFV production essentially ceased. To speed up the building of the Honved's armored strength the Germans provided 10 Tiger I and 12 PzKw IVH tanks, along with 10 StuG 40 assault guns in May. That was followed by 40 more StuGs in the summer to build up the Hungarian assault gun battalions, and in September-November 1944 50 Hetzers (plus 50 more in early 1945) were supplied for the same units. This permitted the creation of two battalions with Zrinyi II, two with StuGs, and four with Hetzers.



Light Tank, 38M Toldi

This was a modified license-built version of the Landsverk L-60, the main changes being the substitution of a Büssing-NAG engine for the original Scania model, and the unfortunate choice of the 20mm 36M anti-tank rifle with 208 rounds as the main armament, paired with a coaxial 8mm machine gun. The original A20 model was succeeded by the B20 Toldi II, featuring only minor detail improvements. The short 1941 campaign on the Eastern Front conclusively proved the Toldi to be unreliable (particularly the engine), undergunned and poorly armored. An improved model was designed that increased the frontal armor thickness to 35mm and modified the turret by extending the rear to accommodate a larger gun. Retrofitted vehicles were designated the Toldi IIa and were armed with the 40mm 42M gun with 55 rounds and a coaxial 8mm machine gun. Unfortunately, by the time the Toldi IIa was ready it too was obsolete.

Toldi 38M light tank (PMK)



	Weight (tonnes)	8.5	Front Armor (mm)	13
	Length (m)	4.75	Side Armor (mm)	13
	Width (m)	2.14	Engine HP	155
	Height (m)	2.05	Road Speed (km/h):	50

Medium Tank, 40M Turan

The Hungarians modified the Skoda T-21 tank by enlarging the turret ring, increasing the armor thickness slightly, replacing the Czech armament with Hungarian, and fitting a Hungarian radio. The turret was enlarged to accommodate three men, an important boost to efficiency. The main weapon was the 40mm 41M gun for which 101 rounds were carried. Two 8mm MG 34/40 Gebauer machine guns were carried, one coaxial and one in the superstructure front for the radio operator. The 41M Turan II was similar, but replaced the 40mm gun with the 75mm 41M short-barrel gun, raising the center of the turret roof to accommodate it. From mid-1944 vehicles returned for repairs were fitted with additional perforated armor skirting around the turret and superstructure. A Turan III with a long 75mm gun, providing a much-needed improvement in anti-tank capability, never got past the prototype stage.

Turan 40M medium tank (PMK)



	Turan I	Turan II	Turan I	Turan II
Weight (tonnes)	18.2	19.2	Front Armor (mm)	60
Length (m)	5.50	5.50	Side Armor (mm)	40
Width (m)	2.44	2.44	Engine HP	260
Height (m)	2.39	2.44	Road Speed (km/h)	43



SP Gun, 40M Nimrod

The Nimrod was a license-built version of the Landsverk L-62 "anti" air defense vehicle. It mounted a single Bofors 40mm L/60 automatic cannon (also license-built in Hungary) in a three-man turret. The chassis was that of the L-60 tank (Toldi in Hungarian service).

Ammunition stowage was 160 rounds. No secondary machine gun armament was fitted. Two batches of Nimrods were built, which differed only in the engine, the first 46 having German Büssing-NAG units and the second 89 the Hungarian near-copy Ganz VIII engines.

Although designed as air defense vehicles, the shortage of gun-armed tanks caused these vehicles to be used as tank destroyers with AP ammunition for their guns. Although nimble, their very thin armor and weak gun made them inefficient in this role.



Nimrod 40M self-propelled 40mm (PMK)



Weight (tonnes)	8.0	Front Armor (mm)	13
Length (m)	4.75	Side Armor (mm)	10
Width (m)	2.14	Engine HP	155
Height (m)	2.10	Road Speed (km/h)	50



Assault Gun, 40M Zrinyi

The Zrinyi was an assault gun based on the chassis of the 40M Turan medium tank. To accommodate the gun the chassis was 46cm wider than the standard tank, but with the same engine and suspension. The armament was a 105mm 40/43M howitzer fitted in a ball mount and provided with 52 rounds of HE and AP ammunition. The ammunition was of the separate loading type, which slowed the rate of fire somewhat. A machine gun was carried inside the vehicle for local ground defense dismounted. The Zrinyi had a low profile, in fact it was 25cm lower than the StuG40, had good armor protection and a useful weapon, and it proved popular with the troops. An anti-tank variant, the Zrinyi 75, was also developed to carry the 75mm 43M long gun, but only four were built before production came to a halt.



Zrinyi 40M 105mm assault gun (PMK)



Weight (tonnes)	21.5	Front Armor (mm)	75
Length (m)	5.90	Side Armor (mm)	n/a
Width (m)	2.89	Engine HP	260
Height (m)	1.90	Road Speed (km/h):	40

Armored Car, 39M Csaba

Derived from the earlier AC-II, the Csaba was the only entirely indigenous Hungarian AFV. The vehicle featured an advanced four-wheel drive system and two drivers, one facing forward the other rear. The two-man turret mounted a 20mm 36M anti-tank rifle with 200 rounds and a coaxial 8mm 34/37A machine gun with 3,000 rounds. Of 93 Csabas built, 12 were command vehicles armed only with a machine gun, but with a long-range radio and frame antenna. The vehicle was of modern design and had good cross-country performance, but suffered from thin armor and the semi-automatic AT rifle provided little firepower. Designed for the close confines of central and western Europe, it proved too lightly-built for the long distances of the Russian steppes, where the rear-facing driver would have been of little use.



Weight (tonnes)	5.9	Front Armor (mm)	9
Length (m)	4.52	Side Armor (mm)	n/a
Width (m)	2.10	Engine HP	90
Height (m)	2.27	Road Speed (km/h):	65

Csaba 39M armored car (PMK)





Italy

Pre-War Vehicles

Italy's introduction to tank production came at the very end of World War I. France was unable to provide the FT tanks Italy required, so Fiat was directed to build a close copy. The resultant vehicle was given the company designation of Fiat 3000 and the army designation Model 21, and closely resembled the French original but was armed with twin 6.5mm machine guns. An order was placed for 1,400 vehicles but the war ended before the start of deliveries and the quantity was subsequently reduced to 100, these being delivered in 1921 and 1922.

Maneuvers in mountainous regions in 1929 showed the Mod 21 to be underpowered. A design effort was undertaken that yielded a tank that was, strangely, not significantly more mobile than the original, but was armed with a long-barrel 37mm gun. The new tank, known as the Fiat 3000B or Model 1930, was essentially identical to the Model 21 but replaced the two light MGs in the turret with a new 37mm L/40 gun. A contract for 48 vehicles was placed and these were delivered in 1930. Most were armed with the 37mm gun, but a small number appear to have received the twin MG armament. Some of the older Mod 21s appear to have been retrofitted with the new gun as well.

Italian tank development took a different, and unfortunate, turn when OTO purchased four Carden-Loyd Mk VI machine gun carriers from Britain, along with kits for another 21 vehicles in 1929. These vehicles, designated the CV.29 in Italian service, proved inexpensive and simple to produce, relying largely on commercial components. OTO had acquired an exclusive Italian license for the Carden-Loyd carriers through 1934, but Ansaldo, in league with Fiat, had their own ideas. The Ansaldo munitions factory at Fossati (Genoa) was set up to produce tanks and the two firms developed a modified version of the CV.29 that seems not to have violated the license. The first model, known as the CV.33 (later L3/33) carried a single machine gun, but was quickly replaced on the production line by the somewhat improved CV.35 (L3/35).

That the simplicity of design speeded production is indicated by the fact that by June of 1936 there were already 1,100 CV.33 and CV.35 in the inventory, comprised of the first order for 100 and 931 of the second order for 1,300. After this initial burst, however, production slowed considerably, the remaining 369 tanks being delivered in the following three years. This very wealth of vehicles, however, had its downside. With



JANE'S TANKS OF WORLD WAR II

Below: A tank unit Commander (and pet) relax on a L3/35 pre-war time.

the Fossati works occupied (in part through export orders) and the Italian Army nearing its full complement of vehicles there was little incentive or money to develop new models.

Battles in Spain showed the L3-series to be vulnerable to almost all kinds of enemy fire, while the conflict in Ethiopia clearly demonstrated the limitations of the semi-fixed armament. Thus, it was 1938 before significant work was undertaken on the design of a new, turreted, tank. This put Italy 4 to 5 years behind the other major powers, a gap it was not able to close as war drew nearer and then exploded into combat.

The inefficiency of Italian tanks caused a moderate amount of consternation in military circles, yielding some debate but no clear policy until 19 November 1938 when an army circular defined the types of tanks needed. This established that there would be L (light), and M (medium) tanks. The L tanks would weigh about 5 tons and be armed with machine guns. Two types of M tanks were envisioned, one weighing seven-ten tons with twin MGs in a turret, and the other of eleven to thirteen tons with two MGs in a turret and a 37mm gun in the hull. The next month the requirements were refined, so that the L tank mount a 13.2mm MG

in the hull, the lighter of the M tanks a 20mm gun in a turret, and the heavier M tank a 47mm gun in a turret. Also introduced was the concept of a heavy (P) tank, also with a 47mm gun in a turret.¹

It is not clear to what extent Ansaldo influenced this array, but they were already in the design stage on similar vehicles. The heavier M tank in the first circular described almost perfectly the vehicle that would become the M 11/39. Designed for the infantry support role, it was a slow-moving vehicle with a hull-mounted 37mm gun suitable for use against known, non-moving targets, with twin MGs in the turret. In December 1938 War Minister Pariani directed the procurement of 100 of these tanks with deliveries to run between May and November 1939. A second series of 400 vehicles would be modifications of the first set, but with a 47mm gun in a turret, to conform to the revised specifications.

The M 11/39s appear to have been delivered roughly on time, although an inability to produce the 37mm L/40 guns meant that at least a portion of them had to be taken from Mod 30 tanks. Of the limited production run, 70 were kept in Italy to form two battalions, while 24 were sent to East Africa. None survived combat very long, their armor proving vulnerable, the main armament unsuited to mobile warfare, and the lack of a radio making

co-ordination almost impossible.

The lighter of the M tanks envisioned also, whether by coincidence or not, matched an Ansaldo product. They had begun development of a six-ton tank armed with a 20mm gun in the turret for possible export sales, probably spurred by their success selling the CV series of vehicles.

For armored cars, Italy relied on the survivors of 110 Lancia 1ZM vehicles built in 1917. These were mostly replaced by 46 Fiat 611 armored cars built in 1935. These followed the conventional pattern of the time, being built on 6x4 truck chassis with 8-15mm of armor and a turret with a gun and MG. The gun in this was the 37mm L/40 also seen on the mod 30 tank. The Fiats and Lancias were used in the war in Ethiopia and many stayed there to be destroyed in the fighting in 1941.

A much better armored car was on the horizon. In late 1937 the PAI (African Colonial Police) began formulating a requirement for a new vehicle with much improved cross-country performance. Then, in April 1938 the Army announced a requirement for a similar vehicle. Two prototypes, known as AB 39, were built at the new Fiat factory in Mirafiori (Turin), one for each service, and shown in May 1939. The car was found to be a significant improvement over the Fiat 611 and was ordered by both forces.

As a result an initial order was placed for 24 vehicles, to be known as the AB 40. Most of these were armed with two 8mm Breda M38 machine guns coaxially mounted in the turret and a third weapon in the rear of the hull crew compartment.

Thus, when Germany invaded Poland in September 1939 the Italian armor force was still built almost exclusively on the little L3 tankettes, these even equipping the three armored divisions being formed. Partial deliveries had been made of a small batch of ineffective medium tanks. Other vehicles were on order, but they were to prove no match for what other countries were producing.

Wartime Tanks

On entry into the war in June 1940 the Italian Army's stocks of armored vehicles consisted of



¹This also laid the foundation for the Italian designation system, which comprised an initial letter (L, M or P), followed by the weight in tons, then the year of adoption. Thus, the M 11/39 was an 11-ton medium tank adopted in 1939.



Right: Two M11/39s pass a stopped truck convoy

1,320 L-3/35 tankettes, 127 old Mod 21 and Mod 30 tanks, 100 M-11/39 tanks, and 34 Lancia 1ZM and 48 Type 611 armored cars. Certainly far from an impressive force.

Ansaldo's efforts to turn the M 11/39 into a more modern vehicle, with turret-mounted armament and a radio, paid off fairly quickly. This was accomplished by retaining many of the automotive components and lower hull of the M 11/39, and the 47mm L/32 antitank/infantry gun recently adopted by the infantry as the primary weapon. The former expedient reduced the horsepower-to-weight ratio from 9.53 hp/tonne to 7.5 due to the greater weight. The adoption of the 47/32 gun was not without opposition, but it was felt that delay was unacceptable. Work was continued on a more powerful 47mm L/40 gun, but as events turned out it was not available in quantity until mid-1942, by which time it was nearly obsolete.

The first order for the resulting tank, the M 13/40, was for the 400 planned and was placed in late 1939. In March 1940 a further 241 were ordered as Italy prepared for its entrance into the war. Shipped to North Africa in early 1941 they proved much superior to the M 11/39. Nevertheless, they were underpowered and, by the end of the year, had proven undergunned. The first shortcoming was tackled by the



introduction of a more powerful engine. The new vehicle was the M 14/41, which differed from its predecessor only in the new engine and improved air cleaners suited to desert conditions, which improved reliability. Initial orders for 1,810 M-13/40s were reduced to 710 in September 1941 with the balance to be completed as M-14/41s.

The final evolutionary step of the Italian medium family was the M 15/42. This featured two major improvements and a variety of smaller modifications. The old 47/32 gun was

finally replaced by the new 47/40, designed as a tank weapon. The second change was the replacement of the diesel engine with a gasoline engine, increasing road speed. Other alterations included electric turret traverse and thicker turret armor. The first production M 15s, however, did not come off the line until 1943 and saw no combat in North Africa.

What had been the lighter of the medium tank concepts also went forward, but as a light tank, designated the L 6/40. Although flawed, the L 6 was a significant improvement on the old L 3 series, with armor protection and a weapon comparable to most of its foreign contemporaries in 1940, and fitted for a radio. The vehicle's main shortcoming was its two-man crew. With the driver fully occupied by his duties, the remaining crewman could not efficiently be a commander, a gunner, a loader, and, as required, a unit commander. Nor can a two-man crew be expected to pull normal unit details, such as security, and perform routine maintenance every night, although in this respect they may have been aided by the unique Italian practice of assigning trucks and trailers (with drivers) to each tank platoon, light and medium (except those in North Africa), to transport the tanks in non-tactical situations. The L 6s were the only tanks assigned to the



Left: An M11/39 probably in Northern Italy, 1939



Russian Front by Italy.

A total of 583 L 6s were ordered with delivery starting in 1940, but 300 of them were diverted to SP chassis. Later orders partially made up for this diversion. They were the only tracked combat vehicles not built at the Ansaldo works, but by Fiat.

Design capacity was apparently as limited as production capacity, for little new showed up during the war. A heavy tank, the P 40, was designed starting in 1940, although this continued to use the running gear of the earlier M-series of medium tanks. The first prototype was tested in 1942, but changes in armament, from the 75/18 to the 75/32 and finally the 75/34, and engine meant that few had been produced by the Italian surrender and none served with Italian forces. Such vehicles as had been produced were seized by the German Army. A prototype called the Fast Sahariano tank, utilizing a Christie suspension with four wheels per side and similar to British cruisers, also appeared but went no further.

Certainly a major bottleneck in the provision of new tanks to the Army was that there was only one medium tank factory and only one engine producer. In October 1939 Ansaldo notified the Secretary of War that their capacity was 25 tanks

per month, with a surge of 50% more if the Fossati plant could be relieved of producing other munitions. This rate appears to have been the basis for future planning, for a few days later Pariani stated that the recently-ordered M 13s were to be produced at an initial 15/month, after four months this was to rise to 30/month and for 1941 to 36/month. In fact, once Italy joined the war, capacity was greatly expanded, so that in 1941 production of M tanks and derivatives averaged 78/month. For comparison, Britain that year built cruiser and infantry tanks at almost 400/month. Even the 1941 figure, however, was to be the peak. Under the pressure of reduced raw materials, changing priorities and, later, air raids, production dropped significantly the following year and thereafter.

There does not appear to have been any effort to retrofit vehicles to a later standard. One exception appears to be the old L-3 series of tankettes. Some were retrofitted with 20mm anti-tank rifles in 1939/40, and 84 were converted to flame-thrower vehicles in 1942/43.

Assault Guns

The Italian artillery seized on the assault gun concept early and eagerly. There is some dispute

as to whether Ansaldo was already working on an assault gun version of the M 13 when artillery Colonel Berlese suggested it in late 1940, but work certainly proceeded rapidly. Official sanction for the project was granted on 16 January 1941 and a prototype was shown on 10 February.

The initial order was placed on 18 March 1941, for 30 assault guns (semoventi) and 10 command vehicles, followed on 1 June by another order, this time for 30 + 20, then in December two orders totalling 176 + 66. The first 15 semoventi were delivered in May 1941. The semoventis proceeded in parallel with the M-series tanks. The first batch of 30 were based on the M 13 tank, the second and third orders being completed with the up-engined M 14 chassis, and the remainder with the M 15 chassis. By late 1942 the semoventis were proving the only effective armored vehicle available, and in December of that year army headquarters took the radical step of introducing a new organization table for the tanks' battalions that reorganized them as one company of M tanks and two companies of Semoventi 75/18s. This was the first introduction of these vehicles into the armored branch, they previously having been the province of the artillery.

The 75/18 was a useful infantry support weapon but improvements were always sought, and by 1942 it had lost most of the marginal tank-killing power it had had a year earlier. Two paths were defined to improve the Semoventi fleet. For the traditional assault gun support role the 75/18 was to be replaced by a 105mm L/25 howitzer. The second path consisted of mounting the 75mm L/34 gun envisioned for the P 40, turning it into a tank destroyer. One battalion of 105/25s was issued to the Ariete II division in time to take part in the fighting in Rome, but no 75/34s had been issued. Both types, however, were used by the Germans.

The above assault guns all formed a single family, representing improvements to the basic concept of the 75/18. Two other models, however, were completely different.

The Semoventi 90/53 was developed

Above: An M13/40 with side door open, in Italy, 1941



	1940	1941	1942	1943 ^a	Total
Production					
Light Tank L6/40	n/a	n/a	n/a	n/a	402
Medium Tank M13/40	234	475	-	-	710
Medium Tank M14/41	-	376	319	-	695
Medium Tank M15/42	-	1	104	115	220
Heavy Tank P40	-	1	-	-	1
Semoventi 47/32	-	n/a	n/a	n/a	282
Semoventi 75/18 on M40	-	60	-	-	60
Semoventi 75/18 on M41	-	-	162	-	162
Semoventi 75/18 on M42	-	-	2	188	190
Semoventi 75/34 on M42	-	-	1	60	61
Semoventi 75/34 on M43	-	-	-	1	1
Semoventi 90/53	-	-	30	-	30
Semoventi 105/25 on M43	-	-	-	30	30
Command Vehicle M13/40	-	30	-	-	30
Command Vehicle M14/41	-	-	49	-	49
Command Vehicle M15/42	-	-	-	45	45
Ammunition Carrier L6	-	-	30	-	30
Armored Car AB41	-	250	302	72	624
Conversions					
L3/35 to 20mm	-	-	52	32	82
Imports					
Infantry Tank R-35	-	109	-	-	109
Cavalry Tank S-35	-	33	-	-	33
Medium Tank PzKw IIIN	-	-	-	12	12
Medium Tank PzKw IVH	-	-	-	12	12
Assault Gun StuG IIIG	-	-	-	12	12

^a a thorough July

Wartime Armored Vehicle Deliveries

specifically to counter the Soviet T-34 tank, which would have proven impervious to the 47mm guns and 75mm howitzers in service in 1941. The gun would have been effective, but the layout was inefficient and the chassis overloaded, and the 30-vehicle regiment that was formed never left Italy, being deployed to Sicily where it was destroyed.

At the lighter end of the spectrum was the Semoventi 47/32, which took the standard 47mm L32 gun and put it on the chassis of the L6/40 light tank. It was designed to provide fire support for the 20mm-armed armored cars and light tanks.

Armored Cars and Carriers

Wartime armored cars were derivatives of the AB 40. The main production model, and indeed the dominant model through the war, was the AB 41. Fast, with adequate cross-country mobility and armament, it was, nonetheless, very poorly armored and featured the same type of

inefficient one-man turret that plagued the L6/40 light tank. It was used in all theaters from 1941 on by cavalry armored car battalions.

Apparently impressed with the British Daimler scout car, the Italian army commissioned Lancia to develop a near-copy. The result was the Lince (Lynx), which differed from the original primarily in the fitting of a ball-mounted Breda 38 machine gun to the superstructure front. An order for 300 was placed with Ansaldo, but none were produced before the armistice.

Another British product that seems to have struck the Italian fancy was the Universal Carrier. A prototype of the Cingolletta 2800 was built, very similar to the British original but with an additional road wheel per side (thus anticipating the T16), but no production was undertaken.

An indigenous vehicle was the Carro Protetto AS37, which fitted a light armored body to the 4x4 AS37 light desert truck. The vehicle could carry ten troops, plus the driver, and was armed

with a Breda 38 machine gun. It appears not to have progressed beyond the prototype stage.

Self-Propelled Artillery

No SP indirect-fire artillery went into production. A design was worked out for mounting the 149mm L/40 gun on a strengthened P 40 chassis and plans were made to produce 20 vehicles during 1943, but in fact only one vehicle was delivered before the armistice terminated the program.

Italy also produced a number of SP mountings for 75mm, 76mm and 90mm AA guns, but all were unarmored vehicles that usually involved simply bolting the gun on the rear bed of a military truck and adding stabilizing jacks.

Foreign-Built Vehicles

During 1940 Italy requested substantial aid from Germany, including 300 armored cars and 1,566 tanks. In December the number of tanks was reduced to 800. The Germans rejected this request outright, offering instead ex-French tanks, to consist of 50 B-tanks, 50 S-35s (without radios) and 350 R-35s. Deliveries began in February 1941, but ended in the summer incomplete. These were used initially as training vehicles for the Centauro division before being handed over to form a regiment and several separate battalions.

Italian attempts to procure a production license for the Pz III and/or Pz IV proved equally unavailing, due both to German reluctance to part with their technology and obstructionist roadblocks put up by the Fiat/Ansaldo consortium fearful of losing their monopoly on tanks. Indeed, no further deliveries were to take place until 1943. Early that year Hitler agreed to provide 20-30 tanks for Italian units in Tunisia but these, and a few others, were held up in Sicily when North Africa finally fell. The Italian General Staff seems to have thought that these would be turned over to the Italian Army there, but in fact they were apparently used to fill out the Hermann Goering Division. The first actual deliveries came in the summer and not to the Army, but to the Blackshirts, who received twelve each of Pz IIIN, Pz IVG and StuG III. These were used to form the M Blackshirt division, which was taken from the MVSN and redesignated the

second Centauro Armored Division in July after the fall of Mussolini. There were plans to replace these vehicles with Panthers, but it is unclear if these ever reach fruition. The Germans also promised 25 Pz III and 7 StuG III to the Italian forces on Sardinia, but once again it is not known if this actually came to pass.

Post-Armistice

The Army of the RSI retained very few armored vehicles, which they formed into one armored car company and two tank battalions, equipped mostly with M-series tanks and semoventi 75/18s. The vast majority of Italian holdings of armored vehicles were taken over by the Germans, who also kept the Ansaldo works busy with additional orders for their existing product lines.

Production after the armistice is not well documented, but the most reliable figures appear to be 28 M-14/42 and 101 P-40 tanks (of which 40 P-40 lacked engines and were used as pillboxes); 55 semoventi 75/18 on M-14/42 chassis; 109



semoventi 75/34; 11 semoventi 75/46; 91 semoventi 105/25, 41 M-14/42 command vehicles; 102 AB-41 and AB-43 armored cars; and 129 Lince scout cars. Almost all of these were taken over by the German Army.

Above: A Semovente 75/18/5 in North Africa

Tankette, L 3/35

Based on the Carden Loyd machine gun carrier, the L 3 series proved disappointing in combat. The crew of two was seated side-by-side with the driver on the right and the gunner on the left. In the earlier L 3/33 the armament was a single 6.5mm Fiat Model 14 aircraft machine gun, but in the more numerous L 3/35 it was upgraded slightly to a twin mounting of 8mm Breda 35 MGs. The mounting could traverse a total of 40° and elevate from -20° to +20°. A small number of L 3/33s in North Africa had their MG replaced by a 20mm AT rifle. Some of each model were also converted to flame-thrower vehicles, and others were built as command vehicles with RF-1-CA radios. The thin armor, poor visibility, inadequate and poorly-mounted armament and lack of radio (in the standard vehicle) made the L 3 series a deathtrap in combat.

An L3/35 on postwar display (PMK)



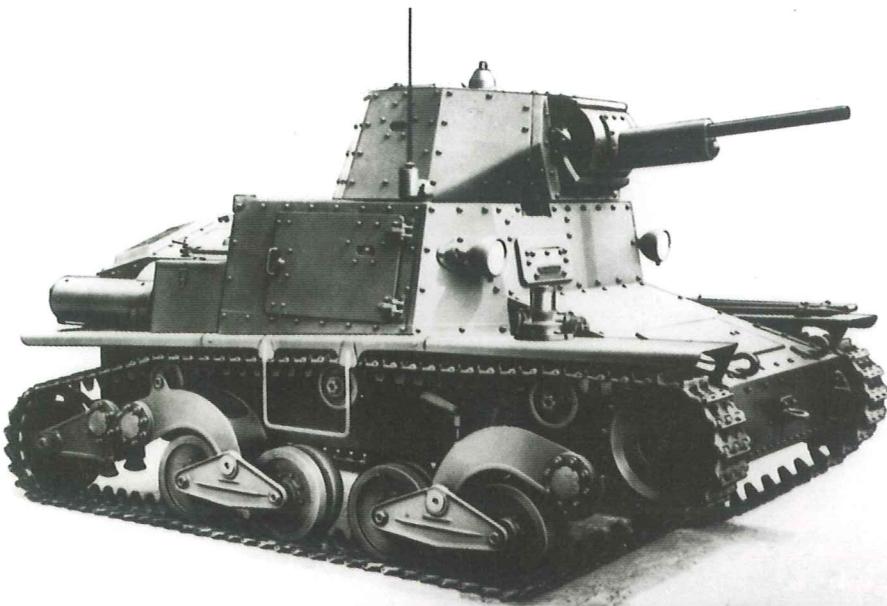
	Weight (tonnes)	3.2	Front Armor (mm)	13
	Length (m)	3.17	Side Armor (mm)	9
	Width (m)	1.40	Engine HP	43
	Height (m)	1.28	Road Speed (km/h)	42



Light Tank, L 6/40

At first glance the L 6 appears little different from many of the other light tanks produced in 1939/40. Yet it had some significant limitations that were not as apparent. It had a crew of two: a driver and a gunner/commander, which limited its effectiveness both in the combat and scouting roles. While the armor was on a par with other light tanks of the time, it was somewhat underpowered and the suspension limited cross-country speed. The armament consisted of a 20mm Breda 35 gun autocannon with 296 rounds, with a coaxial 8mm Breda 38 machine gun. L 6s were fitted to accommodate the RF-1-CA radio, but it is not clear if all were so equipped. A small proportion were fitted with flamethrowers in lieu of the 20mm guns, but no other modifications appear to have been made during its career.

L6/40 Light Tank (PMK)

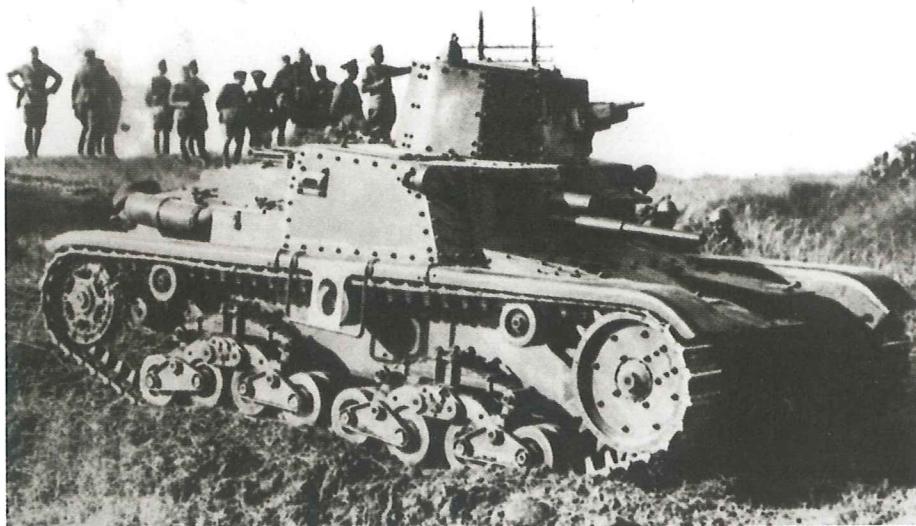


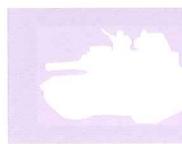
	Weight (tonnes)	6.7	Front Armor (mm)	30
	Length (m)	3.78	Side Armor (mm)	14
	Width (m)	1.92	Engine HP	70
	Height (m)	2.03	Road Speed (km/h)	42

Medium Tank, M 11/39

The M11 is certainly a contender for the dubious distinction of being the worst medium tank to see combat with a major power. The main armament was a 37mm L/40 gun designed in the late 1920s, set into a sponson on the right side of the hull with 30° of traverse. A small turret carried a twin mount of 8mm Breda M38 machine guns. The vehicle had a crew of three, meaning that one person had to aim and load the main gun. The lack of a radio proved a great tactical disadvantage in the initial tank battles of North Africa, where almost all were quickly lost. This tank introduced the suspension that was to be used on subsequent Italian mediums, four pairs of small roadwheels on two main springs each side, making high-speed cross-country mobility difficult even if a suitable engine had been developed.

M11/39 Medium Tank (PMK)



	Weight (tonnes)	10.9	Front Armor (mm)	30
	Length (m)	4.73	Side Armor (mm)	14
	Width (m)	2.18	Engine HP	105
	Height (m)	2.30	Road Speed (km/h)	33



Medium Tank M13-series

The most common Italian tank in the North African tank battles was the M 13/40. The crew consisted of the driver on the left and the bow gunner/radio operator on the right in the hull, and the commander and gunner in the turret. The bow gunner manned a pair of 8mm Breda 38 MGs. Turret armament consisted of a 47/32 gun and a coaxial Breda 38, with a fourth MG mounted for AA defense. The main gun was designed by Bohler of Austria in the mid-1930s as a towed weapon serving as both an infantry support and anti-tank gun. The compromise in characteristics meant it did neither very well, and its armor penetration was less than one would expect for a 47mm tank gun. The M 13 adopted the automotive components and lower hull of the M 11 in order to speed introduction into service which, given the increased weight, made it underpowered. It also proved prone to mechanical breakdown in the desert and the armor plate was of poor quality, sometimes shattering completely when impacted. The vehicle proved acceptable, if somewhat flawed, in the fighting in 1941, but had been completely outclassed by 1942.

The M 14/41 was identical to the M 13 but replaced the engine with a more powerful version and added more capable air cleaners to handle the desert environment.

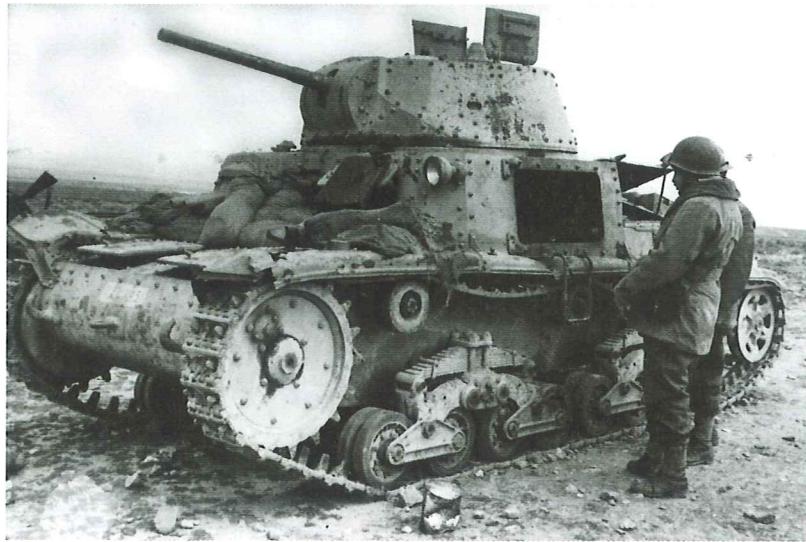
The final version of this family was the M 15/42, representing a substantial, if considerably belated, upgrading of the vehicle. The old 47/32 gun was replaced by a 47mm higher velocity L40 gun designed specifically for tank use. Turret armor was thickened and, for the first time, electrically powered traverse was provided. Previous versions had been powered by diesel engines, but the new M 15 opted for a gasoline engine to get greater output, yielding a slightly increased road speed of 40 km/hr.

Unfortunately, by the time the M 15 entered production in 1943 these improvements were far too little and too late.

First column M13/40

Second column M15/42

	Weight (tonnes)	14.0	15.5
	Length (m)	4.92	5.04
	Width (m)	2.20	2.23
	Height (m)	2.37	2.39
	Front Armor (mm)	42	42
	Side Armor (mm)	25	42
	Engine HP	125	192
	Road Speed (km/h)	32	40



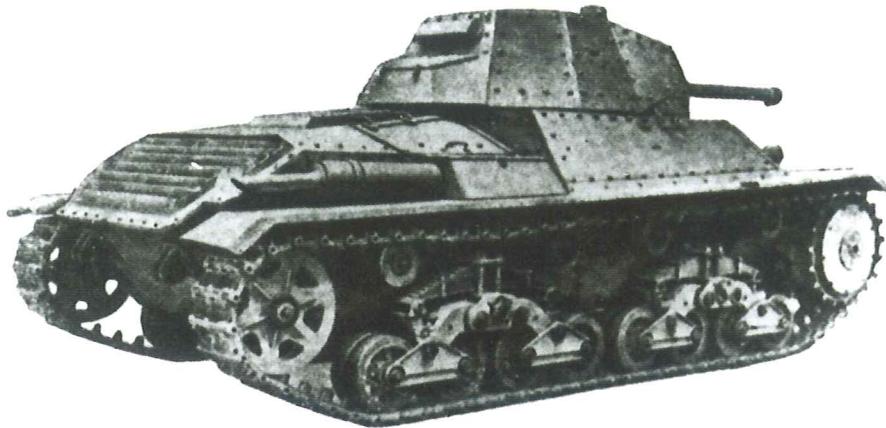
Top: A GI examines an M13/40 through its open side door (PMK)
Middle: An M13/40 on the move (PMK)
Bottom: M15/42 Medium Tank (PMK)



Heavy Tank, P 40

Actually a medium tank by international standards, the P 40 was armed with a moderately effective 75mm L/34 gun with 75 rounds and a coaxial 8mm Breda 38 machine gun. The hull featured a much better shape than the earlier M-series of tanks, but still used the old paired-bogey suspension. The diesel engine used on the prototypes proved unreliable and was replaced on production models by a gasoline version. A shortcoming of the tank was the continued Italian reliance on a two-man turret crew, a loader and a commander/gunner. The other two crewmen, the driver and the radio operator, sat in the hull front. The P 40 was generally analogous in capabilities to the US M4 Sherman, with a slightly better gun but almost certainly considerably less reliable and with an inefficient crew arrangement. Delays in production meant that none were in service at the Italian surrender.

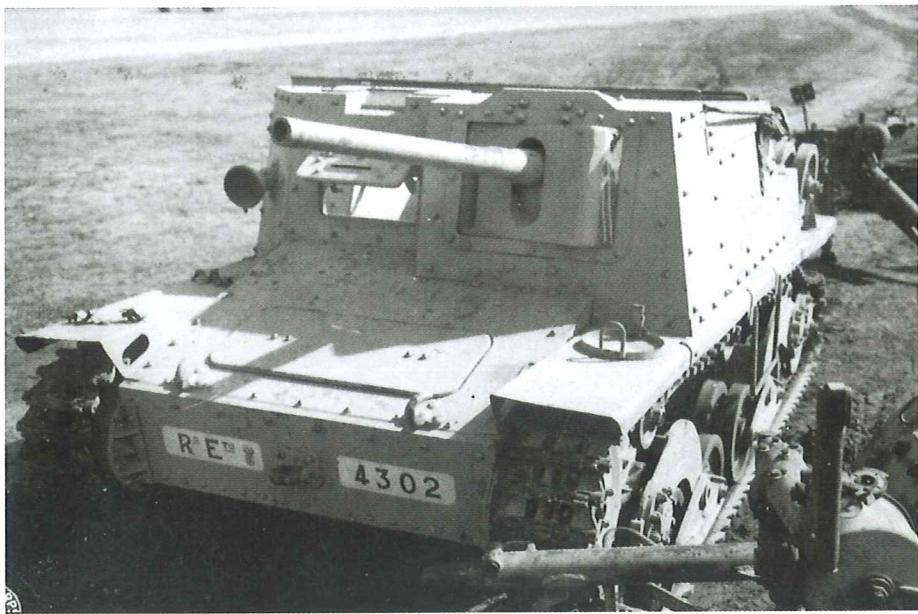
P40 Heavy Tank



	Weight (tonnes)	26.0	Front Armor (mm)	60
	Length (m)	5.75	Side Armor (mm)	50
	Width (m)	2.75	Engine HP	420
	Height (m)	2.50	Road Speed (km/h)	40

Semoventi 47/32

This was the smallest of the assault guns, being based on the L 6/40 light tank. It had a crew of three: commander/gunner, loader and driver. The sole armament was the 47mm L/32 gun used on the medium tanks, for which 70 rounds of ammunition were carried, and it had a total traverse of 27° and an elevation range of -12° to +20°. Early production vehicles were open-topped, but later vehicles had an overhead cover. The small size of the vehicle certainly made it a difficult target to engage but left little room for ancillary equipment, such as a machine gun or a radio. A command version was built, in which the main gun was replaced by an 8mm Breda 38 machine gun, with the space thus created used for a radio. One such vehicle was assigned as the command vehicle of each Semoventi 47/32 company.



	Weight (tonnes)	6.7	Front Armor (mm)	30
	Length (m)	3.80	Side Armor (mm)	14
	Width (m)	1.86	Engine HP	70
	Height (m)	1.72	Road Speed (km/h)	36

A captured Semoventi 47/32



Semoventi 75/18

The original version of the Italian assault guns, this vehicle initially mated the chassis and automotive components of the M 13 medium tank with a new casemate and the 75mm L/18 howitzer. The main gun had a traverse of 18° left and 20° right, and an elevation range of -12° to +22°. Forty-four rounds were carried for the howitzer in a mixture of HE and AP. A machine gun was carried for dismounted use or on an open AA mount. Here again, the vehicle was undermanned, with a crew of 3: a commander/gunner, loader/radio operator, and driver. Later vehicles used the M 14 and M15 chassis. A command version removed the gun and added observation equipment, a second radio, and twin 8mm (M 13) or a single 13.2mm (M 14/15) machine gun fitted to the right front hull.

Semoventi 75/18 (PMK)



	Weight (tonnes)	14.4	Front Armor (mm)	30
	Length (m)	4.92	Side Armor (mm)	25
	Width (m)	2.20	Engine HP	125
	Height (m)	2.37	Road Speed (km/h)	32

Semoventis 75/34 and 105/25

These two similar vehicles represented improvements to the original 75/18 models, but taken in different directions. The use of a 75mm L/34 gun turned the vehicle into a tank destroyer, while the 105mm L/25 howitzer increased its effectiveness in the general support role considerably. The use of larger guns, with longer recoil, reduced traverse slightly, to 16° left and 18° right. The tank destroyer carried 42 rounds and the assault gun 48 rounds for their guns. A Breda 38 MG was carried for AA defense. Both used the M 15 chassis. The armament in both cases was good, but the vehicles suffered from the same problems as the earlier semoventi; a three-man crew and relatively thin armor. No 75/34s and only about a dozen 105/25s had been issued to units by the time of the armistice, although they were used by the RSI and the Germans.

Semoventi 105/25



First column 75/34		Height (m)	1.80	1.75
Second column 105/25		Front Armor (mm)	42	50
Weight (tonnes)	15.0	Side Armor (mm)	42	25
Length (m)	5.04	Engine HP	192	192
Width (m)	2.23	Road Speed (km/h)	40	35

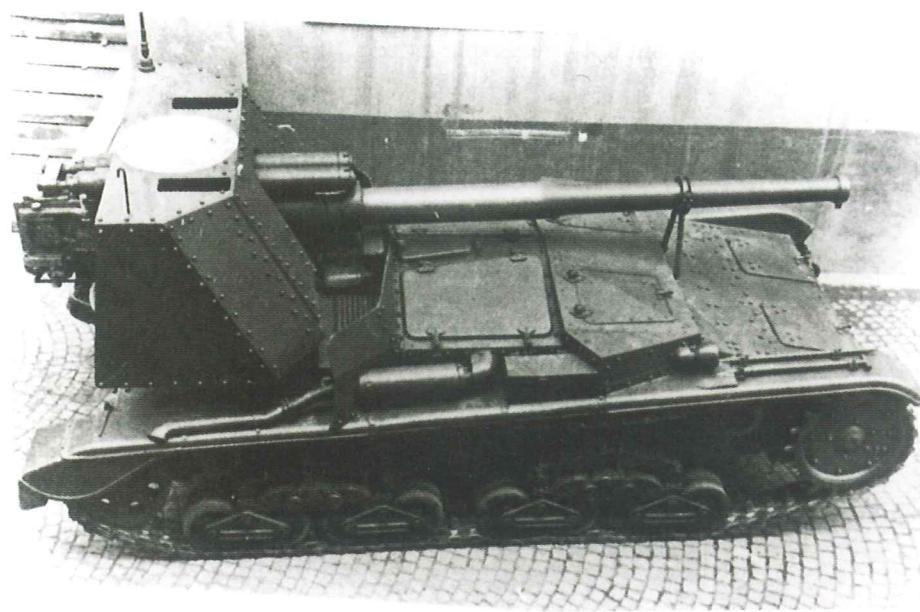


Semoventi 90/53

This was the chassis of the M 14/41 tank fitted with a platform at the rear on which was mounted the 90mm L/53 anti-aircraft gun for use as a self-propelled anti-tank and artillery piece. The weapon could traverse 40° each side of center and elevate from -5° to +24°. The 90/53 was a powerful weapon; unfortunately the overall the improved design had many shortcomings. The gun overloaded the chassis. The crew of five comprised the commander, three gun crew and a driver. The vehicle carried only six rounds of ammunition (all AP).

Further ammunition was to be carried by an ammunition vehicle based on the L 6 light tank (26 rounds) and in a trailer (40 rounds) towed by the semoventi or L 6, with this load being 1/3 AP and 2/3 HE. Only frontal protection was provided to the gun crew, in the form of a shield.

Semoventi 90/53

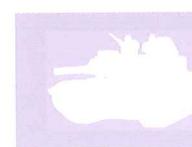
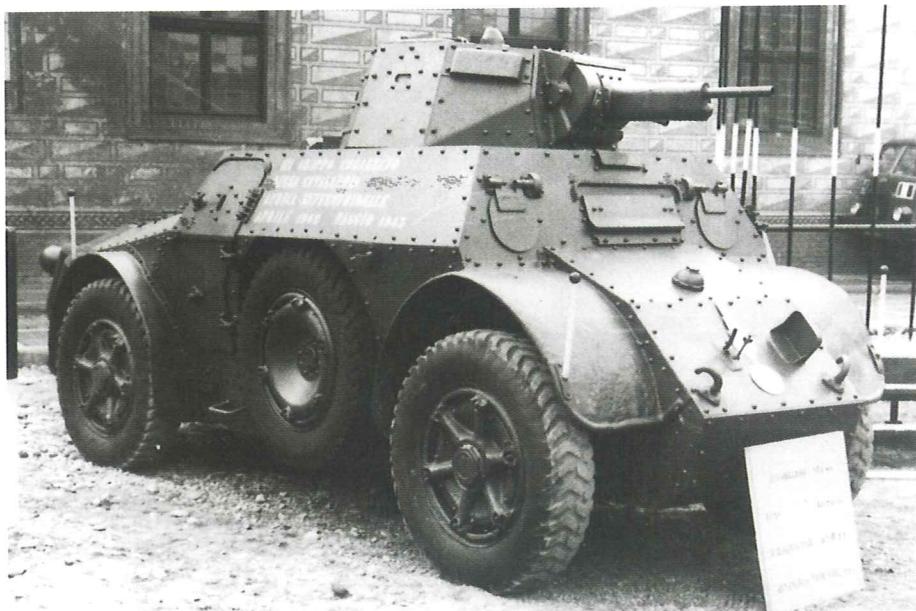


Weight (tonnes)	17.0	Front Armor (mm)	40
Length (m)	5.20	Side Armor (mm)	25
Width (m)	2.20	Engine HP	154
Height (m)	2.14	Road Speed (km/h)	35

Armored Car, AB 41

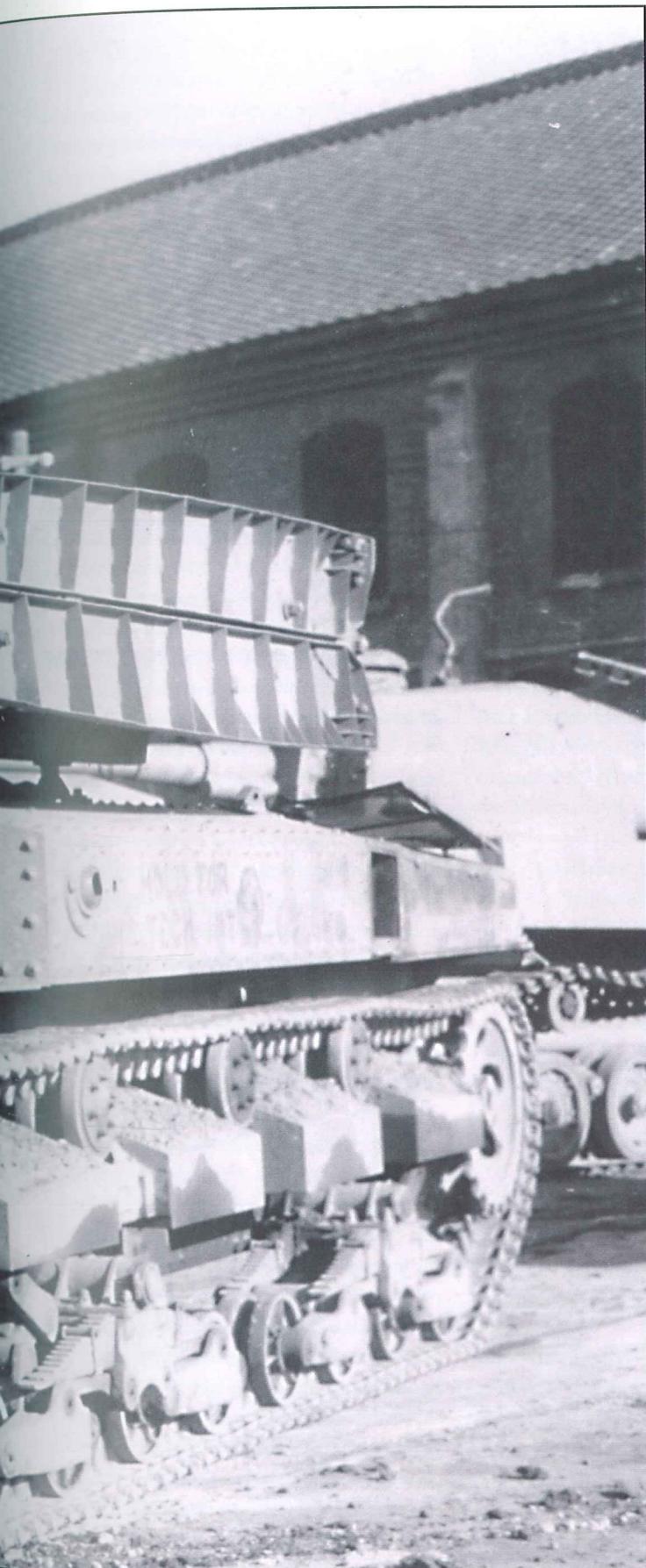
The wartime armored cars used a conventional frame structure on to which were bolted armor plates. Drive was to all four wheels and all vehicles carried radios. All models had an 8mm machine gun facing out the rear of the crew compartment but differed in their turret armament: the AB 40 with twin MGs, the AB 41 (most common) with a 20mm autocannon and a coaxial MG, and the AB 43 with a 47/40 tank gun and a coaxial MG. Cross-country performance was good but the armor was extremely thin, offering only nominal protection, and the crew arrangement was inefficient: two drivers (one facing front, one rear), a hull machine gunner/radioman, and, in the turret, the commander/gunner/loader. Some other armored cars offered driving controls at the rear for a quick retreat, but few wasted manpower to provide a dedicated rear-facing driver who, due to limited visibility, could not contribute much else.

AB41 armored car



Weight (tonnes)	7.4	Front Armor (mm)	15
Length (m)	5.20	Side Armor (mm)	9
Width (m)	2.33	Engine HP	80
Height (m)	2.40	Road Speed (km/h)	76





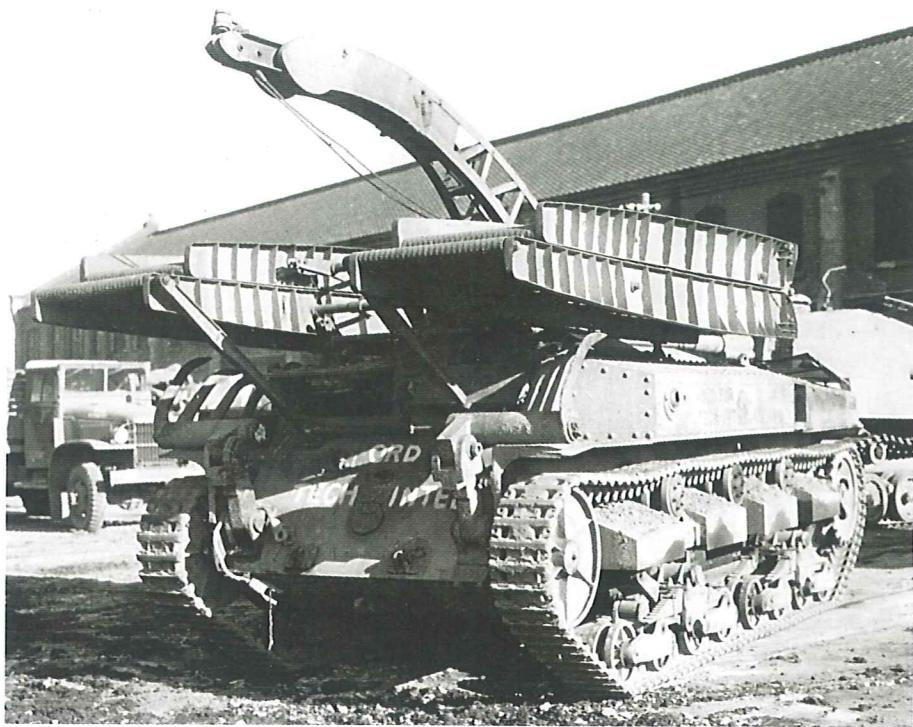
Japan

The Japanese were as curious about Western armored vehicles as they were about all other forms of weaponry. During the 1920s they purchased evaluation examples of a number of different armored vehicles, including Austin, Vickers and Woolseley armored cars; and Whippet, St. Chamond and FT tanks; and Carden-Loyd machine gun carriers. The only vehicle to be purchased for service use was the Renault NC tank, ten of which were ordered and delivered in 1929. Based on the armored car designs Chiyoda built about a 100 early-type armored cars based on their 6x4 truck chassis and armed with 6.5mm machine guns.

Unwilling to import war materials the IJA formed the 4th Military Laboratory in the Okubo district to design and develop motor vehicles and related items. The 2nd Section of the laboratory was responsible for tanks and armored cars. While most countries new to tank-building started out with small vehicles, Japan launched straight into what was, for the time, a medium tank. The Type 89 medium tank was accepted for service in 1929 and deliveries began in 1931. Responsibility for production of the tank was handed over to Sagami Arsenal, which built some tanks and farmed out production of components and, in some cases, entire tanks to civilian firms, primarily Mitsubishi. Two versions of the Type 89 were built simultaneously, the 89A with a gasoline engine and the 89B with a diesel engine. In addition, since this was the first tank to be designed in Japan, detail improvements were needed and introduced at varying stages during the production run of both models, leading to a bewildering array of subvariants. In 1933 Kokura Arsenal began building engines for the Type 89B and in 1935 they completed their first tank, although they were not to be a major producer, turning out only 13 Type 89A and 8 Type 89B before switching to other models.

The production of armored vehicles was confusing and often chaotic. Administration and oversight of production was exercised by two arsenals, Sagami and Kokura. Sagami had broad responsibility for all models, but shared production authority with Kokura for Type 89A, 89B and 97 Mediums, Type 95 Light, and Type 94 Tankettes. About 10% of the output of tracked vehicles (by value) was made by Kokura Arsenal until 1943, when all manufacture was transferred to Sagami.

The arsenals only built about 10% of tracked vehicles in-house, the rest being built under contract by civilian industry. Before 1940 twelve civilian plants were provided with facilities for the manufacture of tracked



vehicles, but in all cases but one the manufacture of such vehicles was a secondary responsibility and they continued the production of their primary goods. The only plant to build solely armored vehicles was the Mitsubishi Heavy Industries plant in Tokyo (also known as the Tokyo Engineering Works). It produced about 35% of all combat vehicles turned out during the war, including 75% of all medium tanks and 50% of the light tanks. The second-largest producer of tanks was Hitachi's Kameari works, built in 1938 for the manufacture of heavy-duty cranes and machine tools. Production of tanks continued here to the end of the war, but accounted for only about 30% of its output. In 1942 the Hino Heavy Industry plant in Tokyo was built for the express purpose of building armored vehicles, concentrating on lighter armored vehicles. In sum, the picture is one of a large number of producers, each producing small quantities of vehicles, most of them as a side-line to their existing business. In addition, the Nanman Arsenal in Harbin produced small quantities of Type 97 mediums during the war, presumably under the auspices of the Kwantung Army.

With the decision to strike south rather than

against the Soviet Union in 1941, the priority accorded the production of tanks began to drop and for the 1943 and 1944 fiscal years dropped from an A-1 rating (the highest) to a D rating (a low rating), although it partially returned to a B-4 in 1945.

The Type 89 was ungainly and thinly-armored (although really no worse than its contemporaries), but its low-velocity 57mm gun threw a more effective HE round than most tank guns of the period. A companion heavy tank, the Type 91, was a failure and never entered series production in spite of continued improvements.

The slow Type 89 was clearly unsuited to support the cavalry and that requirement led to the development of the Type 92 combat car. By the standards of 1932 the vehicle was fast and had an acceptable armament, but its very thin armor left it vulnerable to almost all weapons and the lack of a radio limited its usefulness in the reconnaissance role.

The combat car proved an evolutionary dead end and instead attention was turned to two new types of vehicles that would set the stage for the IJA tank force through most of the war. The tiny Type 94 tankette, developed by Hino Motors, was a multi-role infantry vehicle that combined the features of the Vickers light tanks of the 1930s, a two-man crew with a single light

machine gun in the turret, with those of the French UE armored resupply tractor. It could tow a tracked trailer as an armored resupply vehicle or, by dropping off its trailer, undertake scouting missions. The vehicles were organized into companies, each of four 4-vehicle platoons. In the relatively unthreatening environment of the campaigns in China they performed satisfactorily.

The Type 95 light tank was to undertake more substantive reconnaissance missions in support of the medium tanks. The design owed some of its features to the Type 94 tankette, but was larger and accommodated a third crewman in the hull, where he could man a ball-mounted machine gun but do little else of use. The larger turret accommodated a 37mm gun facing one way and a machine gun facing the other but was still large enough only for one man, who had to serve as tank commander, gunner and loader. A competition to replace the Type 95 resulted in a Mitsubishi prototype with four large road wheels each side and a Christie-type suspension and a Hino prototype with six small roadwheels on three bogies. The Hino model, which was slightly smaller and faster than the Type 95, was chosen. It retained the same main gun in a slightly modified mount to permit a coaxial MG and utilized a two-man turret, dispensing with the hull machine-gunner. Although it passed its tests and was standardized in 1938 as the Type 98 the Army was reluctant to add another model of tank to its inventory, especially in light of the absence of complaints about the reliable little Type 95, and production did not start until 1942.

The Type 94 tankette was succeeded by the Type 97, a heavier and cleaner-looking vehicle with slightly thicker armor. The main change was the provision for a 37mm Type 94 gun in the larger turret, in lieu of the 7.7mm machine gun. The more powerful armament (albeit at the expense of the sole machine gun) was presumably intended to make the tankette more useful as a combat vehicle, but the still-thin armor and one-man turret really made it unsuitable for this role. In fact, by the late 1930s the main attraction of the tankette was undoubtedly its low price. A Type 94 tankette cost only ¥50,000 and a Type 97 some ¥53,000, compared to ¥98,000 for a Type 95 light tank and ¥146,000 for a basic Type 97 medium.

The shortcomings of the Type 89 medium

Above: The bridge-layer version of the Type 95.

Right: A column of Type 89s in China 1937

(thin armor, low speed, poor anti-armor armament) were readily apparent and development of a replacement began around 1934. Competing designs were examined and in 1937 the selected model was standardized as the Type 97 Chi-Ha. Lower and wider than the Type 89, the new tank had a better suspension, higher speed and thicker armor. It retained, however, the short 57mm gun of the Type 89, as well as the unusual feature of mounting the turret machine gun in the rear of the turret rather than coaxially. Looking to the future, the Type 97 featured an enlarged turret ring that would permit later upgunning. This also permitted the adoption of a two-man turret crew so that the commander no longer had to act as gunner as well. Production began at Mitsubishi, Sagami Arsenal and Kokura Arsenal in 1938. It quickly became the standard Japanese medium tank and, along with its closely-derived successors, formed the backbone of IJA tank strength to the end of the war.

The early operations in China were undertaken by this mixture of infantry tankette companies and light tanks and medium tanks in nominal tank regiments (actually battalions). Three tank regiments were formed in 1933 with Type 89 mediums, and the following year the Kungchuling Mechanized Mixed Brigade was formed in Manchuria with a new 4th (light) Tank Regiment, a motorized infantry regiment and an artillery battalion. Equipment problems kept the mixed force from being a success, but as production of tanks ramped up additional tank regiments were formed for the infantry support role.

Two tank regiments (including the 4th Light Regiment) had deployed to the fighting at Nomonhan, but had taken heavy losses and achieved little. The incident made it clear that a more powerful anti-tank weapon was required for the medium tanks than the short-barrelled 57mm and work was begun on a high-velocity 47mm gun. The 47mm Type 1 gun entered production in 1941 and, with a new turret, was installed on the body of the Type 97 medium as the Shinhoto (new turret) Chi-Ha. From early 1942 all Type 97 mediums produced were the Shinhoto version. Since no seats were provided



for the turret crew, it proved simple (if probably uncomfortable) to add a loader to the tank crew about 1943. In addition to new production, about 300 of the older models were retrofitted with the new turret and gun in 1943-45, leaving about 800 of the old 57mm versions to soldier on to the end of the war.

By the start of the war with the West the IJA fielded fourteen tank regiments, two of which were light tank units equipped with Type 95s, while the remainder were medium units, of which three still used the old Type 89s. The tank

forces played a major role in the conquest of Malaya and supported the infantry in Java and Burma, as well as seeing continuous duty in China and guarding Manchuria against perceived Soviet threats.

With the Soviet threat almost eliminated by the German invasion and the conquest of Western holdings proving easy, a period of complacency set in. Little development work appears to have been undertaken and, as a result, the small pre-war chassis of the Type 95 light and Type 97 medium (albeit modified)

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
Combat Car, Type 92	-	-	42	49	44	32	-	-	-	-
Tankette, Type 94	-	-	-	-	300	246	200	70	5	2
Tankette, Type 97	-	-	-	-	-	-	1	56	217	284
Light Tank, Type 95	-	-	-	-	-	31	80	53	115	422
Medium Tank, Type 89A	5	9	8	31	30	15	15	-	-	-
Medium Tank, Type 89B	7	11	61	80	28	36	29	19	20	-
Medium Tank, Type 97	-	-	-	-	-	-	-	110	202	315
Heavy Tank, Type 91	-	1	1	1	1	-	-	-	3	-
Wire Laying Vehicle, Type 97	-	-	-	-	-	-	-	-	-	40
Pole-Planting Vehicle, Type 97	-	-	-	-	-	-	-	-	-	30
Armored Railway Car, Type 95	-	-	-	-	1	10	22	9	8	34
Armored Engineer Vehicle, Type SS	-	-	-	-	40	-	-	-	-	11

Pre-War Production of AFVs by Fiscal Year



Left: Sometimes small size is an advantage. A tankette is pulled out of an irrigation ditch in China, 1938

75mm Type 3 tank gun, a derivative of the Type 90 field gun. This L/38 weapon, although hardly in the forefront of tank armament worldwide, was an adequate weapon and made the Type 3 medium an equal of Sherman. Faint praise perhaps, but the Sherman was the tank the Type 3 was most likely to meet in combat in any invasion of the Japanese homeland. The first Type 3 medium came off the Mitsubishi production line in September 1944. The plan called for 291 Type 3s to be built in April–September 1945, but in fact less than half of that were actually completed.

The quest for a truly new, world-class medium tank was to come to fruition with the 30-ton Type 4 medium Chi-To. Although it used some components from the old Type 97 family chassis, it was longer and wider with an additional road wheel on each side. It featured a large turret with the 75mm Type 5 tank gun, a variant of the Type 88 L/56 anti-aircraft gun. With frontal armor 75mm thick it would have been a formidable vehicle, but production at Mitsubishi (at 20/month) was not scheduled to start until August 1945 and at Kobe-Seiko (at 5/month) a month later. Six chassis were built and two of those completed as tanks before the surrender.

This was to have been followed by the 37-ton Type 5 Chi-Ri, with a hull-mounted 37mm gun and a turret with (initially) a 75mm Type 5 gun and later an 88mm gun. One prototype had been completed, except for the main gun, in May 1945 when the decision was made to defer

had to form the basis of almost all subsequent tanks.

Little was done in the field of light tanks. The Type 2 light tank was identical to the Type 98 except that the turret was made slightly larger for easier crew service and a somewhat more powerful 37mm gun, the Type 1, was fitted. An attempt was made to place a 57mm gun in the Type 95 turret as a retrofit, but this proved impractical as it filled the turret almost completely and the Type 3, as it was known, was not proceeded with. In 1944 a different tack was tried, taking surplus turrets from converted Type 97 mediums, with their short 57mm gun, and retrofitting them on Type 95 light tank chassis. Only small numbers of all these vehicles were finished, with the plans calling for 110 between June and August 1945. Even if these vehicles had entered large-scale production they could have made little contribution, being of obsolete design with a weak armament and an inefficient two-man turret.

The situation with regard to medium tanks was better, but only slightly. Retooling to produce a larger chassis would have been both expensive and time-consuming so the decision was made to try to wring the last bit of capability out of the old Type 97 Chi-Ha chassis. Although it simplified the switch to newer types of tanks it also limited them in weight to about 17 tons, the maximum that the

chassis could handle. The first of the new types to be developed was the Type 1 medium, which doubled the frontal armor thickness of the Shinhoto Chi-Ha and installed a more powerful engine. In fact, although approved in 1941, the first Type 1 did not come off the production line until January 1944. The last Type 97 came off the Sagami line in November 1943 and from Mitsubishi in February 1944, although the Nanman Arsenal in Manchuria continued to build them into early 1945.

Even though the Type 1 medium was not committed to combat, it was clear that it would stand little chance against an M4 Sherman. The primary shortcoming was the 47mm gun, obsolete for medium tank use in the West since about mid-1942. As an expedient a new, larger and taller turret was designed to accept the



Right: A Type 1 Ho-Ni Self-propelled 75mm gun



production indefinitely and concentrate on production of the Type 4.

Although tank development proceeded at a rather leisurely pace, the development of self-propelled guns based on those tanks was actually impressive. The Type 1 Ho-Ni family was designed to give armored fire support to mobile formations. This it accomplished by mounting either the 75mm Type 90 field gun or the 105mm Type 91 howitzer behind an armored shield on the chassis of the Type 97 medium tank. The first 75mm Ho-Ni I, a conversion from a tank, came off the production line in June 1941, and the first 105mm Ho-Ni II in July 1942. The Ho-Ni I and II vehicles were created both by new production and by conversion of existing tanks. The Ho-Ni I would have been an effective, if vulnerable, tank destroyer for its time, but was actually an artillery weapon for indirect fire support.

A similar vehicle for heavier fire support took longer to see service. The initial plan called for the conversion of 25 Type 97 chassis in a manner similar to the Type 1 Ho-Ni vehicles, but with a 15cm Type 38 short-barrel howitzer, in April–May 1945. The vehicles were converted, but the first batch of nine were not completed until April (and hurriedly shipped to Luzon) and the last vehicle was finally finished in August. A follow-on order for 100 more vehicles was to have begun in October, but never started. An even heavier vehicle was the Type 4 300mm SP howitzer, four of which were built in-house by the Sagami Arsenal in August 1945.

The self-propelled artillery, although useful, did not solve the firepower problem faced by tank regiments equipped with Type 95 light and Type 97 medium tanks and their close successors. The vehicles' armament had limited HE capabilities and they were rapidly becoming obsolete for lack of armor penetration. The initial hasty solution was to take old Type 97 Chi-Ha vehicles and rearm them with a new turret with a short-barrel 75mm Type 99 gun. These new tanks were called the Type 2 Gun Tank and one company in each regiment was supposed to be equipped with them, but in fact the production of the guns proceeded slowly and only 30 were built in July 1944, after which production ceased.

The similarly-named Gun Tank Type 3 was, on the other hand, an entirely different creature.

Where the Type 2 was designed to provide HE firepower to support the small, high-velocity guns of the rest of the regiment, the Type 3 was designed as a tank killer with the same 75mm gun as used in the Type 3 medium. The design was identical to the Type 1 SP gun, Ho-Ni I except that the fighting compartment was entirely enclosed by adding a roof and two hinged rear plates, and extending the sides further back. Designed as an interim measure to stiffen the regiments equipped with Type 97 mediums, Hitachi received orders for only 57 vehicles (and completed even fewer).

The IJA also designed a series of unique specialized armored vehicles. The first to see service was the 13-ton Type SS engineer vehicle. Where most armored engineer vehicles were (and are) based on standard tank chassis, the Type SS was unique and was of modular design, enabling the fitting of various mission packages.

Originally designed as a flame-thrower, packages were added for bridgelaying, mine clearing, wire cutting, trench digging, etc. The vehicle was used by engineering detachments. The chassis also formed the basis for the Type 95 tracked recovery vehicle.

Even more numerous was the 8.7-ton Type 95 So-Ki armored railway car. The vehicle resembled a larger version of the Type 94 tankette, but used a different suspension derived from the Type SS and featured a turret without armament. Instead, the vehicle carried four infantrymen in addition to the crew of two. The So-Ki had retractable wheels that could be lowered to fit on railway tracks and moved in or out to accommodate different gauges. The vehicles were mainly used in Manchuria, but some also served in Burma, and probably China as well.

Two variants of the Type 97 tankette were developed to facilitate laying signal wire in

	1941	1942	1943	1944	1945
Production					
Tankette, Type 97	3	35	5	15	-
Light Tank, Type 95	705	655	239	-	-
Light Tank, Type 98	1	24	79	-	-
Light Tank, Type 2	-	-	-	29	5
Medium Tank, Type 97	507	28	-	-	-
Medium Tank, Type 97 Shinhoto	-	503	427	-	-
Medium Tank, Type 1	-	-	15	155	-
Medium Tank, Type 3	-	-	-	55	89
Gun Tank, Type 3	-	-	-	15	16
Amphibious Tank, Type 2	-	-	112	70	-
Amphibious Tank, Type 3	-	-	-	12	-
SP Gun, 75mm, Type 1	-	26	-	-	-
SP How, 105mm, Type 1	-	-	14	20	20
Amphibious Vehicle, Type 4	-	-	18	32	-
Armored Personnel Carriers	-	8	435	385	126
Armored Engineer Vehicle, Type 96 SS	24	16	29	10	-
Armored Observation Vehicle, Type 100	-	80	70	6	-
Armored Railway Car, Type 95	29	16	9	-	-
Tracked Recovery Vehicle, Type 95	28	-	-	-	-
Tree-Clearing Vehicle Ho-K	-	4	15	21	-
Wire-Laying Vehicle, Type 97	40	-	5	55	-
Pole-Planting Vehicle, Type 97	60	-	50	45	-
Conversions					
Type 97 Medium to Shinhoto	-	10	14	40	15
Gun Tank, Type 2	-	-	-	30	-
SP How, 105mm, Type 1	-	-	-	-	8
SP How, 150mm, Type 5	-	-	-	-	12
SP Mortar, 300mm Type 4	-	-	-	-	4
no data for other conversions					

Wartime Production of AFVs by Fiscal Year

rough terrain. One was a pole-planter that could embed poles in the ground, the other had large spools for paying out wire.

Other unusual vehicles were a tree-clearing vehicle based on the Chi-Ha chassis, the Type 100 artillery observation vehicle based on the Type 97 tankette, and other specialized vehicles. All were produced in small numbers only. Under development when the war ended were a conversion of the Type 95 light tank to a small tank killer by mounting the 47mm Type 1 gun in the hull as the Type 5 SP gun Ho-Ru, and a 105mm tank destroyer Ho-Ri.

The IJN used small numbers of armored cars and Type 89 medium tanks in the 1930s, mostly in China, and provision was made in the Special Naval Landing Forces organization tables of 1939 for tank companies, but none of the latter appears to have been formed until 1942. For offensive operations in the Pacific an amphibious tank would be needed. Development had begun on such a vehicle, but they would not be built in time to participate in the initial lightning thrusts to the south and east.

The Type 2 Ka-Mi amphibious tank was a

unique design that incorporated pontoons that fit on to the front and rear of the tank in order to provide buoyancy. Once on land the pontoons were released by cables from within the vehicle, which was then a fairly conventional Japanese-style light tank. The use of these pontoons gave the vehicle the buoyancy it needed, while at the same time the release feature prevented them from compromising the on-land characteristics. Nevertheless, the Ka-Mi was only thinly armored and was provided only with the standard Japanese 37mm gun and two machine guns. By 1943 it was obsolete as a tank, but they were widely distributed through the Pacific with naval ground units.

The Ka-Mi was followed by the larger Type 3 Ka-Chi amphibious tank. This 26-ton vehicle used a similar system of detachable front and rear floats, but was bulkier and was armed with a 47mm Type 1 tank gun and had 50mm of frontal armor. It was a more capable vehicle, but only 19 were built by 1943/44 and opportunities for amphibious warfare had diminished.

One other amphibious vehicle of note was

the Type 4 Ka-Tsu amphibious tractor. This vehicle was analogous to the US LVT series and carried four tons of cargo or 40 troops on to the beach. It had 10mm of armor protection and was armed with two 13.2mm machine guns. A unique feature was that portions of the vehicle were completely sealed so that it could be carried submerged on the deck of a submarine. In the late stages of the war some were modified to carry torpedoes, although their effectiveness in this role would have been slight.

The Army had built four experimental gun tanks by rearming Type 97 Chi-Has with elderly 120mm Type 38 howitzers. The Army did not proceed further but the Navy adopted the idea in 1945 by rearming one or two dozen Chi-Has with their 120mm naval anti-submarine gun.

Efforts were also made to produce armored personnel carriers. There were two models built, both (confusingly) carrying the identical designation of Type 1 armored personnel carrier. Both models were built by Hino, the "Ho-Ha" half-track vehicle and the full-tracked "Ho-Ki". It would seem that only about 100 of the Ho-Ha model were built, the rest being the smaller Ho-Ki.

Tankettes

These vehicles could be used for scouting or, with a tracked trailer, in the resupply role. The original gasoline-powered Type 94 tankette weighed 3,550 kg with armor up to 12mm thick and was armed with a single 6.5mm, and later 7.7mm, machine gun. A door was fitted in the rear to facilitate egress for resupply duties. A tendency to shed its tracks resulted in its replacement by the heavier diesel-powered Type 97, some of which were armed with the 37mm Type 94 gun in lieu of the machine gun. The engine was moved to the rear, which made access easier but reduced the vehicle's utility as a resupply vehicle slightly. Neither vehicle was equipped with a radio, limiting its usefulness in the scouting role. It was often pressed into combat duties, especially later in the war, for which its thin armor and one-man turret made it largely ineffective. Several variants of the Type 97 tankette were built for special tasks.

Type 94 Tankette



First column Type 94,		Height (m)		1.62	1.79
Second column Type 97		Front Armor (mm)	4.2	12	12
Weight (ton)	3.2	Side Armor (mm)	3.70	10	10
Length (m)	3.08	Engine HP		35	65
Width (m)	1.62	Road Speed (km/h)		40	40



Combat Car, Type 92

The Type 92 was the second indigenously-designed armored vehicle to enter production and the first attempt at a light, fast vehicle for the cavalry. It mounted a 7.7mm (13.2mm in later vehicles) machine gun in the hull and a 7.7mm weapon in the turret. Although fairly fast on the roads by the standards of the time, the suspension was not designed for high-speed cross-country travel and was to prove rather weak. The lack of a radio, the one-man turret and entirely nominal armor protection that protected against almost nothing, rendered the vehicle virtually useless in combat. As a result, the combat car saw very little use in the war.



An early model Type 92 with 7.7mm MG in the hull

	Weight (ton)	3.2	Front Armor (mm)	6
Length (m)	3.94	Side Armor (mm)	6	
Width (m)	1.63	Engine HP	45	
Height (m)	1.87	Road Speed (km/h)	40	

Light Tanks

The little Type 95 light tank was the most numerous Japanese AFV of the war. This was presumably due to its small size and lack of complexity, which made it suitable for production on small assembly lines. It had a driver, and a machine gunner/mechanic in the hull, and a commander/gunner/loader in the small turret. Armament was a 37mm Type 94 or Type 98 gun in the turret front and a 7.7mm machine gun in the turret rear, along with another machine gun in the hull front. The replacement was the Type 98, which was a major improvement in using a larger, two-man, turret with a coaxial machine gun, in turn followed by the Type 2, which differed only in detail. Neither, however, was produced in large numbers and the Type 95, with its thin armor and poor crew layout, had to soldier on to the end of the war.

Type 95 light tank with turret traversed to show both main gun and MG

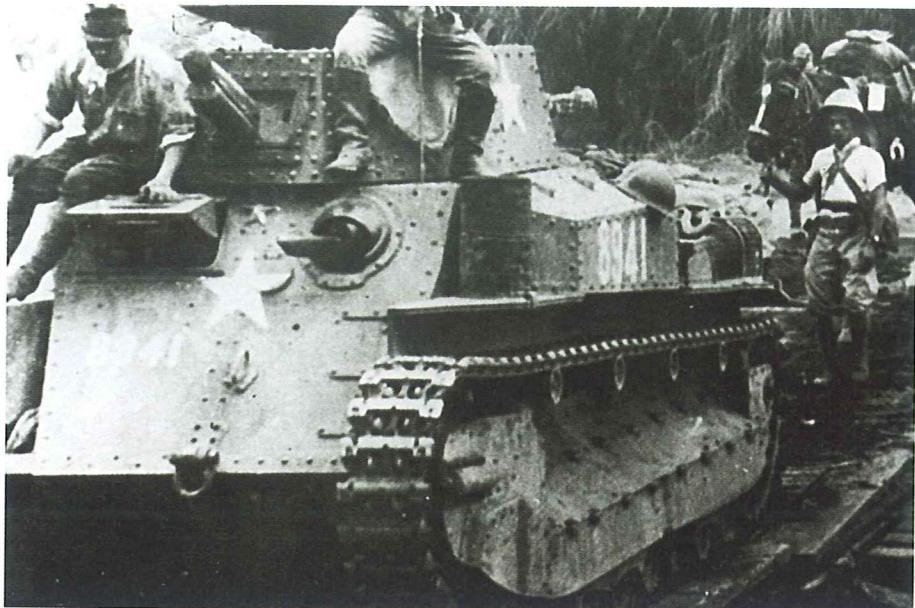


First column Type 95,		Height (m)	2.28	1.82
Second column Type 98		Front Armor (mm)	12	16
Weight (ton)	6.7	Side Armor (mm)	12	16
Length (m)	4.30	Engine HP	120	130
Width (m)	2.07	Road Speed (km/h)	40	50

Medium Tank, Type 89

The first Japanese attempt at tank production, the Type 89 medium was built simultaneously in two main versions, the Type 89A with a gasoline engine and the Type 89B with a diesel. Constantly modified, the Type 89 appeared with many detail changes. None, however, altered the basic attributes of the vehicle: thin armor and a low-velocity 57mm gun.

Thoroughly obsolete by 1941, the Type 89 served thereafter almost exclusively in China, where the absence of enemy tanks and the scarcity of anti-tank guns meant it could still operate with some effectiveness.



A Type 89 medium in Shanghai 1937



Weight (ton)	11.8	Front Armor (mm)	17
Length (m)	5.75	Side Armor (mm)	17
Width (m)	2.18	Engine HP	118
Height (m)	2.56	Road Speed (km/h)	25

Type 97 Medium (Chi-Ha)

The Type 97 was configured with a two-man crew in the hull and two more in the turret. The manually-rotated turret was offset to the left and was irregularly shaped, with the 57mm low-velocity Type 90 gun facing front and the machine gun about 170° off to the rear. A second machine gun was mounted in the hull front. The hull and turret are built of riveted and bolted armor plate. Power was provided by a V-12 air-cooled diesel through a 4F1R transmission. The fighting compartment was lined with asbestos to reduce heat. The Type 97 was clearly optimized for the infantry support role. The 57mm gun threw a useful HE round but was almost useless against other tanks.



Weight (ton)	14.3	Front Armor (mm)	25
Length (m)	5.55	Side Armor (mm)	25
Width (m)	2.33	Engine HP	170
Height (m)	2.23	Road Speed (km/h)	38

Allied soldier in captured Type 97 Chi-Ha



Type 97 Improved (Shinhoto Chi-Ha) & Type 1 Medium (Chi-He)

The Shinhoto (new turret) Chi-Ha featured a turret configuration changed from a nearly circular type to a semi-rectangular shape and, significantly, now mounted a high-velocity 47mm Type 1 gun. It retained the inefficient rear-facing turret machine gun, but a loader was added to the crew. The tracks were made slightly wider to lower ground pressure. The Shinhoto Chi-Ha suffered from a number of shortcomings, including thin armor, a marginal shortage of power, and a weak gun. The Type 1 looked almost identical to the earlier tank but doubled the thickness of the frontal armor on the turret and hull and featured greater use of welding. Armor elsewhere was unchanged. The engine was also replaced by a more powerful model to improve mobility. Offensive power, however, remained a small gun and an inefficiently-placed 7.7mm machine gun. Although accepted for service use in 1941, production did not begin until 1943, by which time reduced resources limited production. In any event, the Type 1 was obsolete by that time.

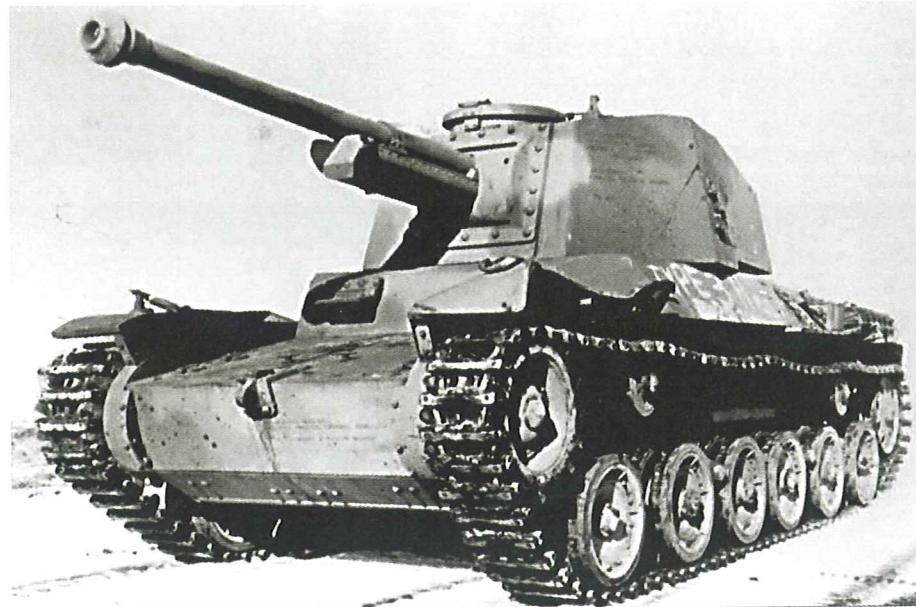


Type 97 Shinhoto Chi-Ha

	Type 97 Imp	Type 1	Type 97 Imp	Type 1
Weight (ton)	14.8	15.2	Front Armor (mm)	25
Length (m)	5.55	5.73	Side Armor (mm)	25
Width (m)	2.33	2.33	Engine HP	170
Height (m)	2.38	2.38	Road Speed (km/h)	38
				44

Medium Tank, Type 3 (Chi-Nu)

The Type 3 medium once again used the basic chassis of the Type 97, as modified with the thicker armor and more powerful engine of the Type 1 medium. A new turret was fitted, with room for a full three-man crew. Most significantly, the underpowered 47mm gun was finally replaced by the new 75mm Type 3 L/38 gun, a modified version of the 75mm Type 90 field gun. To accomplish that, they had to sacrifice any turret machine gun. The Type 3 gun was adequate for its time, although not outstanding. The Type 3 could have handled the Sherman on even terms, but would have been outclassed by the M26 Pershings that would have shown up in any invasion of Japan.



Type 3 Chi-Nu Medium Tank

	Weight (ton)	18	Front Armor (mm)	50
	Length (m)	5.73	Side Armor (mm)	25
	Width (m)	2.33	Engine HP	240
	Height (m)	2.61	Road Speed (km/h)	39

Amphibious Tank, Type 2 (Ka-Mi)

This was the only Japanese armored vehicle to go into series production during the war that was not based on a pre-war design, although it borrowed some components from the Type 95 light. The Type 2 had a full-width superstructure, extending out over the tracks, to improve buoyancy, and large floats were attached at the front and rear for swimming. Once on land the floats could be detached from inside via levers and cables. Propulsion in the water was by means of two propellers, while steering was accomplished by twin rudders on the back of the rear float, controlled from the tank commander's position. The tank mounted a 37mm Type 1 gun and a 7.7mm machine gun coaxially in the one-man turret, and a second machine gun in the hull front. In addition to the three crew members, the vehicle also carried three other men, who served as mechanics and helped install the floats.

Type 2 Amphibious Tank with floats removed but air intake extension still mounted on rear deck. Note hatches to side of turret to allow additional floats.



	Weight (ton)	9.15/12.5	Front Armor (mm)	12
Length (m)	4.80/7.50	Side Armor (mm)	12	
Width (m)	2.80	Engine HP	115	
Height (m)	2.30	Road Speed (km/h)	37	

Self-Propelled Gun, Type I (Ho-Ni)

The Ho-Ni I placed the 75mm Type 90 field gun (less muzzle brake) and a shield on the chassis of the Type 97 Chi-Ha, less the hull machine gun. The gun had a traverse of 10° each side of center and an elevation range of -5° to +25°. It was similar in configuration to the early German tank destroyers, but was an artillery weapon (with range drums calibrated to 12,000 meters) rather than an anti-tank vehicle. The Ho-Ni II substituted the 105mm Type 91 howitzer for the gun. In both cases the lack of any machine gun armament as well as the open top and rear of the fighting compartment would have rendered them very vulnerable in close-quarters fighting. The Ho-Ni I carried 54 rounds of ammunition, the Ho-Ni II 20 rounds.



	Weight (ton)	14.7	Front Armor (mm)	50
Length (m)	5.55	Side Armor (mm)	25	
Width (m)	2.33	Engine HP	170	
Height (m)	2.39	Road Speed (km/h)	38	

Ho Ni I SP 75mm gun



Self-Propelled Howitzer, Type 4 (Ho-Ro)

This vehicle was similar to the Ho-Ni family in that it mounted an artillery piece in a shield on the chassis of the Type 97 medium tank, again without the machine gun. The weapon was the old 15cm Type 38 howitzer, for which 28 rounds were carried. The crew consisted of six men, one of whom was the driver, one the commander, and four gun crew. The gun had a limited traverse of 3° each side and elevation of -10° to +20°. The maximum range is uncertain, but the sights (both direct and indirect fire) were calibrated out to 3,000 meters only. No secondary armament was fitted.

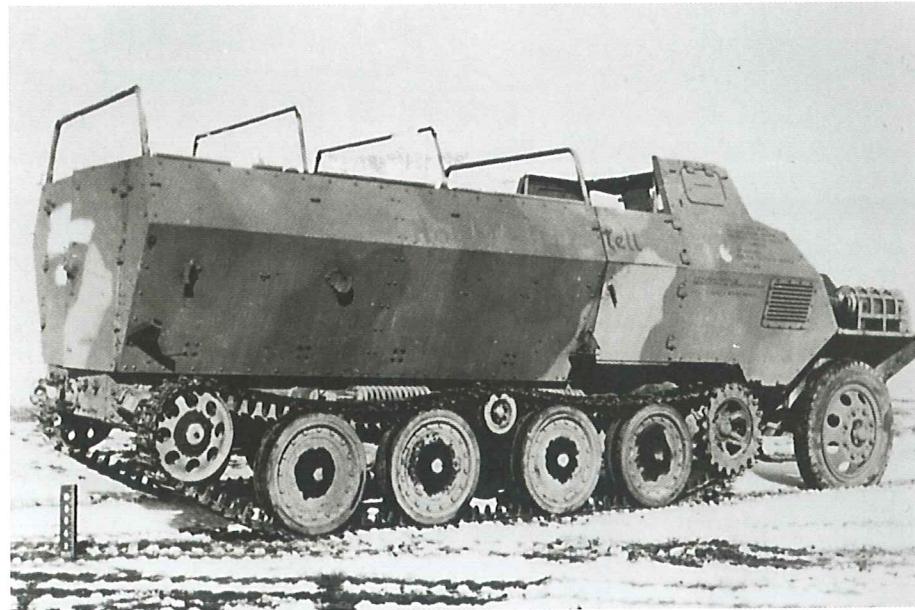


Type 4 Self-Propelled Howitzer

	Weight (ton)	15.5	Front Armor (mm)	25
	Length (m)	5.52	Side Armor (mm)	20
	Width (m)	2.33	Engine HP	170
	Height (m)	2.36	Road Speed (km/h)	38

Armored Personnel Carrier (Ho-Ha)

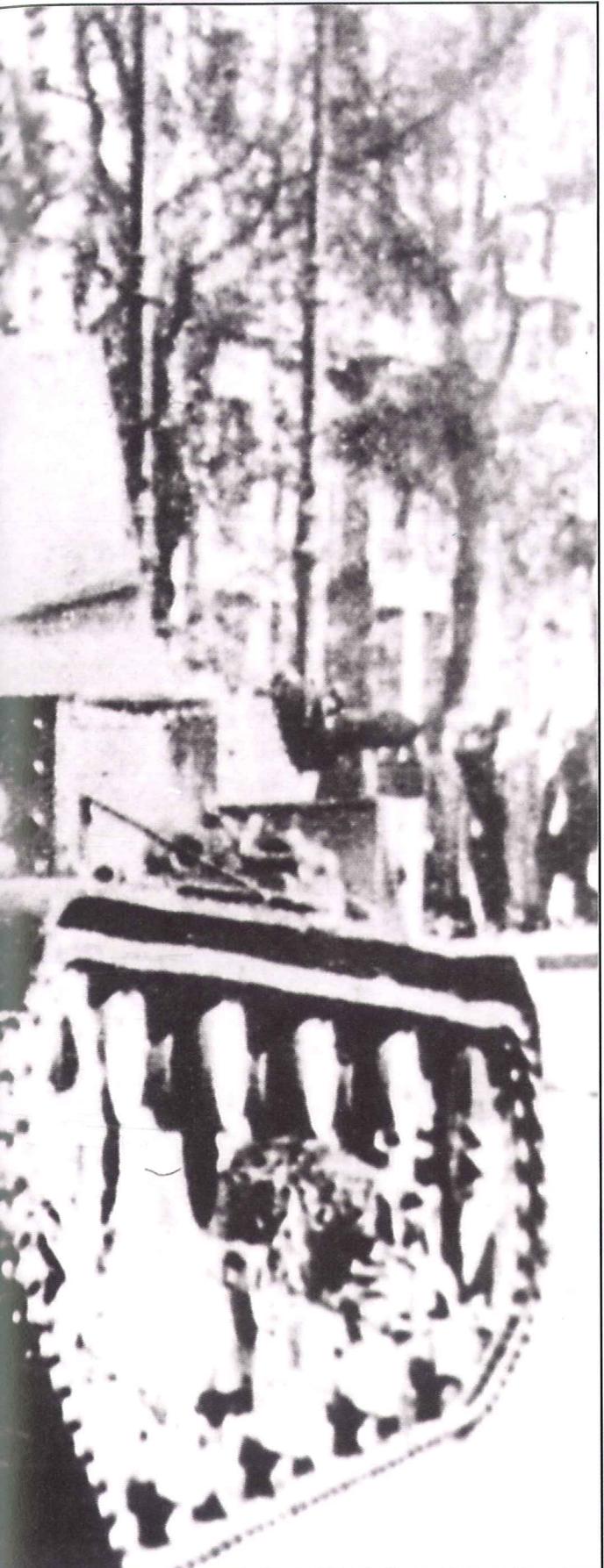
The Type 1 Ho-Ha was a half-track vehicle that seems to have borrowed little from any other designs, although the long track length is suggestive of the German half-tracks, of which Japan received a few examples. The vehicle carried a crew of 2 and 13 troops and was armed with three pintle-mounted 7.7mm machine guns. Access was by a door each side at the forward end of the troop compartment and a pair of doors at the rear. Passengers were seated facing inwards on benches that ran down the length of the rear compartment against the walls. In common with the German half-tracks, the Ho-Ha had an unpowered front axle, relying on the long tracked section for mobility.



Type 1 Ho-Ha Armored Personnel Carrier

	Weight (ton)	7.0	Front Armor (mm)	8
	Length (m)	6.10	Side Armor (mm)	6
	Width (m)	2.10	Engine HP	134
	Height (m)	2.00	Road Speed (km/h)	50





Poland

The Polish Army started the 1920s with 120 FT tanks, the bulk of which survived up to the outbreak of the war. By July 1939 there were still 102 FTs in Polish service, 32 serving with armored trains and 70 forming one tank battalion. A significant number of armored cars of various types were also used in the 1921-22 fighting, but all had been pulled from service by the mid-1930s.

The obsolescence of the FT was clear and after trials Poland purchased 50 Vickers Model E medium tanks and a production license. Of the 50, 38 were delivered whole and the remaining 12 were delivered as components for local assembly that never came about. All 38 were the twin-turret version with a 7.92mm wz.25 Hotchkiss MG in each turret. In May 1932 a contract was placed with Vickers for 22 turrets with 3pdr (47mm) guns to convert twin-turret tanks to the single-turret configuration. The rebuild of the tanks was accomplished in 1934. The remaining 16 twin-turret tanks underwent several armament changes during the 1930s, including the use of 13.2mm MGs and 37mm L/21 guns, but finally reverted back to two 7.92mm MGs (albeit the newer wz.30) in 1937.

The original plan to license-build the Vickers E was dropped when Polish engineers made improvements to the design and launched it as the 7TP light tank. In March 1935 the first order, for 24 twin-turret tanks, was placed and deliveries were completed a year later by the PZInz factory. All subsequent orders were for the single-turret version. Due to delays in turret manufacture, however, the first 16 turrets were built by Bofors and delivered between February 1936 and January 1937. By the time of the German invasion 135 7TP had been delivered and about a dozen more were taken straight from the factory floor into combat during the campaign.

In light of the low production rate of the 7TP efforts were made to bolster the tank force through foreign purchase. Two R-35s were tested in 1938 and found to be slow and poorly armed, but little else was available and in February 1939 an order was placed for 100 vehicles. The first batch of 49 arrived in May and these, with one test vehicle, formed a tank battalion. The German invasion prevented delivery of the balance of the order.

Another purchase from Vickers was a Vickers Carden Loyd machine gun carrier in 1929, but with an eye towards close scouting rather than as a weapons carrier. A few more were purchased for further trials but, although the concept was attractive, the implementation was criticized. After a few failed attempts at an indigenous derivative, the Ursus automotive plant delivered a prototype called the TK-3 that differed from the VCL original mainly in the provision of a

raised armored compartment for the crew. This was accepted for service as the TK scout tank and about 300 vehicles were built by PZInz until 1933 when production shifted to the improved TKS.

The main complaint with the TK was that it was underpowered. The last 18 TKs had been built with a Polski-Fiat engine and this unit was carried over into the new TKS. The new vehicle also had slightly thicker frontal armor and other detail changes. A total of 269 were built before production ceased in 1936.

In January 1939 the Army authorized the retrofit of 150 TK and TKS vehicles with a 20mm gun developed by the Fabryka Karabinow as a small tank destroyer, but only about 24 had been so fitted before the German invasion.

Armored cars had played a major role in the fighting in the early 1920s but the stocks of such vehicles were clearly tired by the end of the decade. Several hundred Citroën Kégresse B-10 half-tracks had been purchased, and 90 of these were set aside for conversion to armored cars. The conversions were designed by the Military Design Office and the Central Auto Workshop (CWS) and the actual conversions carried out by the CWS. The result was necessarily small, the B-10 being quite short for a half-track, and featured a two-man crew with a turret for a

short 37mm or a light machine gun. Designated the wz.28 armored cars, they served from 1928 in maneuvers that highlighted the short service life of the rubber tracks.

As a result it was decided to convert the armored cars to all-wheel configuration and a prototype ran in March 1933. The tests were sufficiently successful that the battalion responsible for the trials immediately rebuilt their 11 vehicles by simply substituting the rear axle of the Polski-Fiat 614 truck for the half-track assembly to yield the wz.34 armored car. Further conversions were undertaken by central facilities to two standards. The wz.34-I also replaced the engine, with a Polski-Fiat 108 automobile engine. The wz.34-II used an improved version of that engine, along with an improved rear axle assembly.

To complement the light wz.28/34 a medium armored car was developed by the PZInz. The wz.29 medium armored car was built on the Ursus 2-ton 4x2 truck chassis and featured a small, but unusual, turret. The octagonal turret featured three ball mounts for weapons, one of which mounted the 37mm SA18 short gun and one the 7.92mm wz.25 machine gun. The third also mounted a wz.25, but was angled upwards at about 75° to allow anti-aircraft fire, although by 1939 this had been discarded as ineffective.

A similar weapon could also be mounted in the hull rear. Because they were bulky and were all but road-bound, only about 10 of these were ordered from the CWS in Warsaw.

Various projects were under way at the time of the German invasion. The 4TP and an amphibious version, the PZInz 130, were to replace the tankettes in the reconnaissance role. The 10TP, with Christie suspension, was to be the medium tank, although it was found overly complicated in 1938 trials and was redesigned. A prototype of the 14TP infantry support tanks was also built in 1939. None of these reached production status before the Polish defeat.

Tankette, TK/TKS

The TK followed the concept of the Carden-Loyd carrier on which it was based, a two-man crew sitting side-by-side separated by the engine. The driver sat at the left and the gunner with his pintle-mounted 7.92mm wz.25 Hotchkiss machine gun on the right. The later TKS model featured detail improvements, including a ball-mount for the machine gun, a slightly more powerful engine (42-hp Fiat replacing the 40-hp Ford), armor plate a little thicker (10mm vs 8mm at the front), and improved vision devices, including periscopes. A small number were rearmed with the 20mm NKM cannon as mini-tank destroyers. The most numerous of the Polish armored vehicles, the TK/TKS were obsolete both in concept and execution by the time of the German invasion. Designed and employed as scout vehicles, the lack of a radio and restricted vision severely limited their usefulness.



TKS tankette (PMK)



Weight (tonnes)	2.6	Front Armor (mm)	10
Length (m)	2.56	Side Armor (mm)	n/a
Width (m)	1.76	Engine HP	42
Height (m)	1.33	Road Speed (km/h)	40



Light Tank 7TP

This was an improvement on the basic Vickers E (6-ton) tank with a more powerful diesel engine and thicker armor. Two-turret models were armed with two 7.92mm wz.30 water-cooled MGs in small side-by-side turrets, and the single-turret model with a 37mm Bofors tank gun and one wz.30 coaxial MG. There were two variants of the single-turret model: one using the original Bofors turret and one with the Polish turret with rear overhang for additional stowage. Although many of the design elements, such as the two-man turret, the bogeyed suspension, and the lack of a radio would soon be identified with obsolescence, in 1939 it was an adequate tank and superior to the PzKw I, PzKw II and PzKw 35(t) that it would meet in combat.

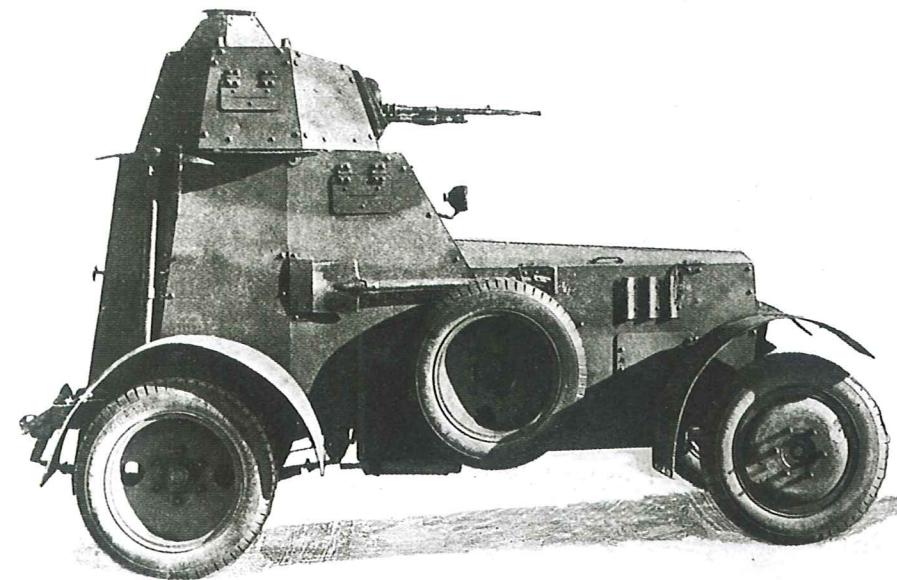


7TP Light Tank

	Weight (tonnes)	9.9	Front Armor (mm)	17
Length (m)	4.56	Side Armor (mm)	n/a	
Width (m)	2.43	Engine HP	110	
Height (m)	2.30	Road Speed (km/h)	37	

Armored Car wz.34

A conversion from an earlier half-track armored car, the wz.34 was short and exceptionally narrow, fitting its two-man crew with the driver in the front and the commander/gunner behind him. The small turret accommodated the short 37mm SA18 gun, for which 96 rounds were provided, in about a third of the fleet. The remainder were armed with a 7.92mm wz.25 machine gun. There were three variants of the wz.34 differing slightly in engine and rear axle components. The vehicle's small size was an advantage, but otherwise it has to be rated one of the worst armored cars to see regular service in WW 2. The two-man crew was overworked, the armor was thin and armament weak, the 4x2 drive provided little cross-country performance, the wooden floor provided no protection against even small mines, and it carried no radio.



The little wz.34 armored car

	Weight (tonnes)	2.2	Front Armor (mm)	8
Length (m)	3.62	Side Armor (mm)	n/a	
Width (m)	1.95	Engine HP	23	
Height (m)	2.22	Road Speed (km/h)	55	





Soviet Union

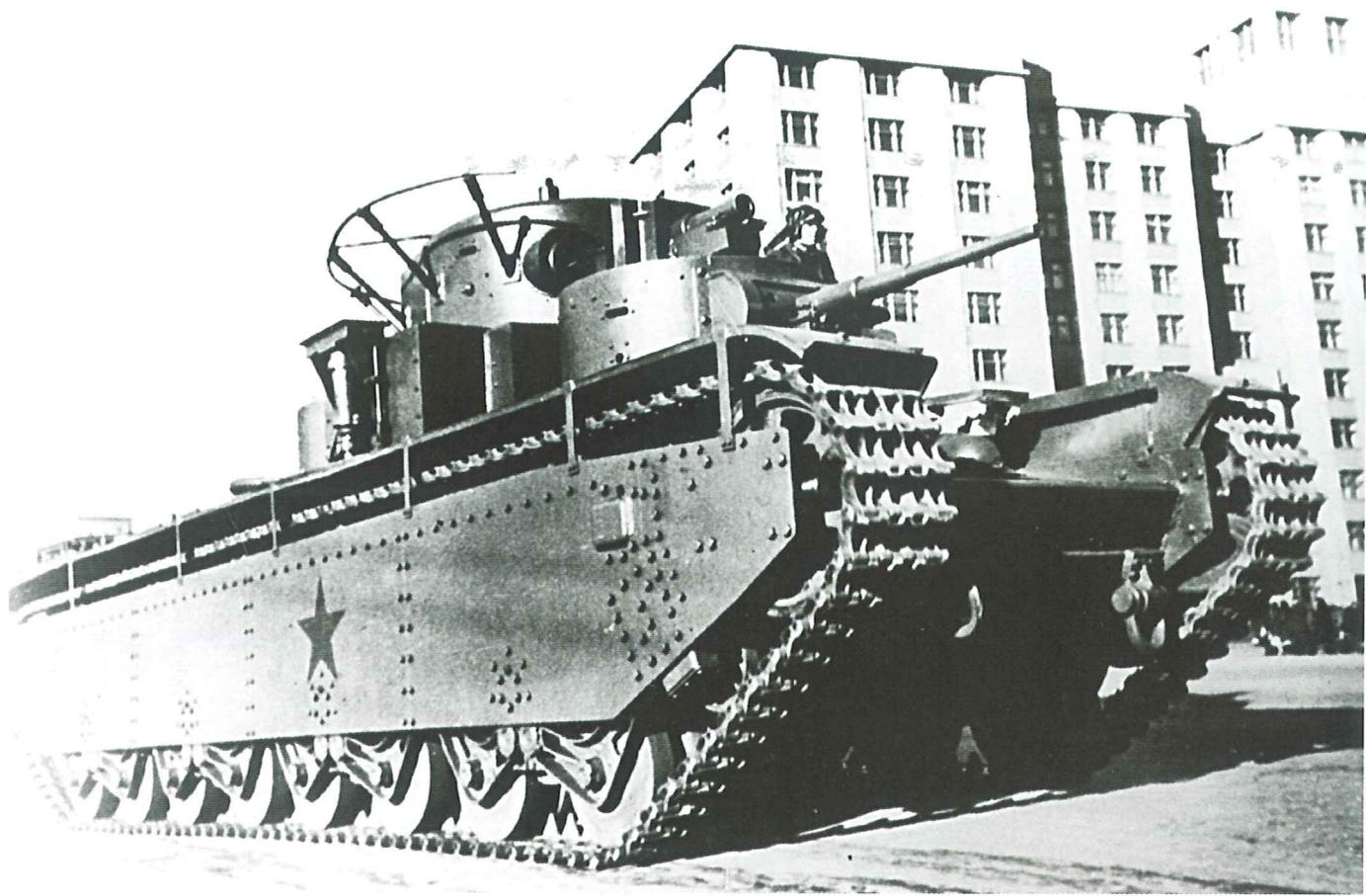
Other than the assembly of armored bodies onto imported truck chassis as armored cars and an abortive attempt to build the FT light tank in 1921, Russian/Soviet industry had no experience in the design or construction of armored vehicles into the mid-1920s. A modernized version of the FT, known alternatively as the T-18 and MS-1, was accepted for service in mid-1927, slightly predating approval of the 1928-32 defense plan. This plan initially concentrated on artillery and aviation, calling only for the modest figure of 250 tanks to be produced. Within a few years, however, this had changed dramatically. Under the "Great Tank Program" of 1931, production in 1932 was to total no less than 540 tankettes, 470 light tanks and 250 medium tanks.

Pre-War Tanks

Lacking an acceptable indigenous design, the Soviets turned to imports. In 1930 they purchased from Britain eight Vickers Carden Loyd Model 1931 amphibious light tanks, fifteen Model E medium tanks, fifteen Mk II medium tanks and 26 Mk VI tankettes. Shortly thereafter they acquired two Christie fast tanks from the US by subterfuge.

The Mk VI tankettes were modified slightly and placed in production as the T-27 at Zavod 37 in Moscow, and further modification yielded the T-27A. Initial plans called for the production of 5,000 of these little vehicles, but their limited tactical utility soon became apparent in maneuvers and efforts were instead concentrated on a turreted vehicle. The Model 1931 amphibious tanks provided the starting point, but the Russian designers incorporated a GAZ-AA engine and suspension derived from the Renault AMR to yield their own vehicle. The resultant vehicle was accepted for service in August 1933 as the T-37 and production begun at Zavod 37. Despite being designed as reconnaissance vehicles, only the command vehicles (known as T-37TU) were fitted with radios, some 643 out of 2,627. A small number (75) were fitted as diminutive flame-thrower tanks.

Efforts to develop a revolutionary scout tank with convertible track features failed, and Zavod 37 was tasked again with improving the breed. The result was the T-38, lower and wider than the T-37 yielding better behaviour in water, but still using the proven GAZ-AA power train. Production ceased in 1938, but started again in 1939 with the improved T-38M, which used the power train and engine of the GAZ-M1. An even



lower proportion of T-38s were fitted with radios than in the T-37, some 165, or about 12%.

The efforts to develop an effective scout tank were largely wasted. The two-man crew and weak armament restricted their fighting ability, while the need for amphibious capability reduced their armor protection so severely they were highly vulnerable. Further, their reconnaissance mission was compromised by the small number produced with radios.

The development of light infantry tanks and fast tanks proved more successful. The twin-turret Model E from Vickers impressed the Red Army and in 1931 a design bureau, known as OKMO, was set up in Leningrad to make detail changes to the design and oversee production there at the Bolshevik factory. Known as the T-26, the first version, the Model 1931, also

featured a twin-turret design, but a small number used a 37mm gun in the right turret and a radio for command purposes. Also built in small quantities were a flamethrower version of the M1931 (known as the OT-26) and a bridge-layer version. A more significant variation came with the development of the single-turret version, the Model 1933. Mounting a 45mm gun with a coaxial machine gun, the T-26 Model 1933 was one of the best tanks in the world in the mid-1930s.

The OKMO bureau continued improving the T-26 through the 1930s. Reports in 1934/35 that the riveted turrets of early Model 1933 tanks were vulnerable to shock caused a gradual introduction of welding. The final batches of the Model 1933 also added two machine gun mounts, one on top of the turret for anti-aircraft use and a second in the rear of the turret. The Model 1938 used a slightly improved 45mm gun. When a new, sleeker turret was introduced the new version was

known as the T-26 Model 1939. Reports from Spain indicated that the T-26 was vulnerable to the German 37mm AT gun, but little armor could be added without overloading the suspension and taxing the already fully-stressed power train. The better angling of the armor added protection without adding weight. Other models included the OT-26 (based on the M1931) and OT-130/131/132/133/134 (based on the M1933) flame-thrower vehicles, the ST-26 bridgelayer tank and a small batch of radio remote-controlled flame tanks. The Soviets were proponents of tank-mounted flamethrowers and a large number were built, but only in the OT-34 was the 45mm gun retained.

The fast tank for accompanying the cavalry was based on the designs of the American Christie vehicles. In April 1930 the Soviet government purchased the chassis of two Model 1930 tanks from Christie's firm, along with a production license. The tanks arrived in 1931 and a new turret was designed, along with some

Above: One of the massive T-35s participates in a May Day parade



Below: A radio-equipped T-26

other components, and the tank was placed in production as the BT-2 light tank. The initial production batch was armed with twin 7.62mm DT machine guns in the one-man turret because the planned 37mm gun was not ready for production and did not arrive until 1933.

By the time the 37mm had become available, however, the switch had been made to the more powerful 45mm 20K Model 1932 gun. A new two-man turret was designed to mount this weapon, along with a coaxial DT. This vehicle entered production as the BT-5 in 1933. The BT-5s were used in Spain in 1937 and at Nomonhan in 1939. All the BT series were wheel-track designs, capable of operation on their wheels alone for long road marches. Their armament proved effective, but they turned out to be quite vulnerable to enemy defenses due to their thin armor.

Influenced by the Vickers Independent tank and the German Grosstraktor (several of which had been shipped to Kazan as part of a secret German-Soviet tank development agreement)

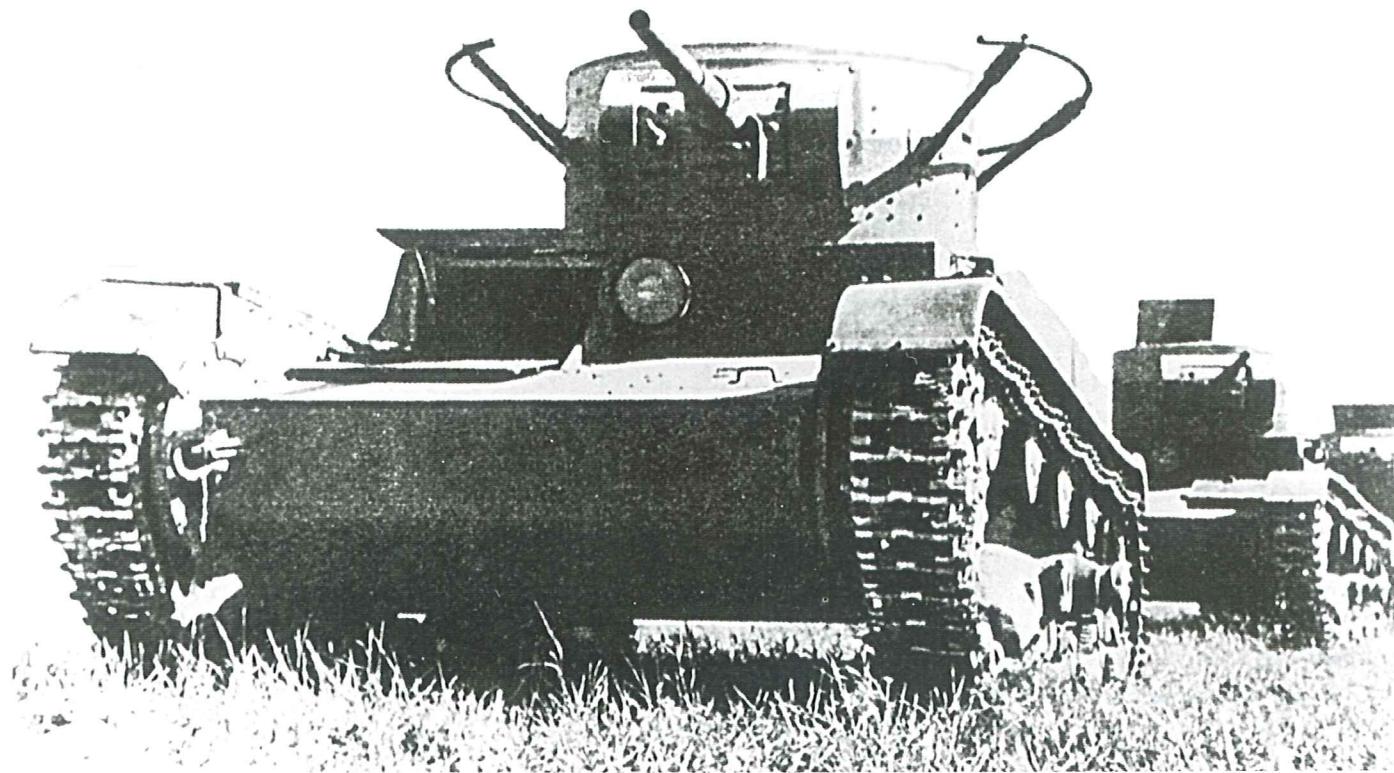
the Soviets also began work on a medium tank to complement the T-26 light infantry tanks. The OKMO bureau in Leningrad was responsible for the effort and turned out two designs, one advanced and the other conventional. The latter was chosen in light of the immaturity of Soviet tank industries and a preproduction batch of ten machines, now known as the T-28, was turned over to the Army in February 1933, with official acceptance following six months later. A fearsome tank for its time, by the late 1930s its thin armor had rendered it vulnerable to enemy fire. Continual improvements were made to the tank, some 600 in all, but failed to eliminate ongoing reliability problems, particularly in the power train.

Even as the T-28 was being developed an even larger tank was also under development. Responsibility for the giant T-35 was given to the AVO-5 bureau, originally formed with German engineers. A prototype was completed in August 1932 and production was ordered in April 1933. The tank was complex, difficult to produce and expensive (costing the equivalent of nine T-26s). It was also seriously flawed with regard to its automotive components, this being

the first tank even approaching this size built in the USSR. As a result it proved unreliable in service and a continual program of fixes failed to remedy the problems, resulting only in a fleet of tanks each of which had slight differences from all the others. In the end only 61 tanks dribbled out of the factory, a considerable waste of industrial resources.

Light Tanks

Although the T-37 and T-38 light tanks were only barely survivable on a battlefield, such vehicles remained attractive to the Soviet leadership because they could be produced by light engineering firms without impacting the production of medium and heavy tanks. Thus, in late 1938, a special team set out to develop an improved version of the T-38. In this they were successful, for the resultant vehicle (designated T-40 in July 1939) was better shaped, better armed and had better amphibious capabilities. The tank was accepted for service in December 1939 and Moscow Factory #37 was directed to deliver the first batch of 15 by 1 August 1940 and to begin full-scale deliveries by October. By June 1941 216 had been delivered, but with the



	1931	1932	1933	1934	1935	1936	1937	1938	1939
Tankettes & Scout Tanks									
T-27	393	1,693	1,242	-	-	-	-	-	-
T-37 basic	-	-	125	946	677	161	-	-	-
T-37 with radio	-	-	-	5	429	209	-	-	-
T-37 flamethrower	-	-	-	-	34	41	-	-	-
T-38 basic	-	-	-	-	-	1,046	17	-	112
T-38 with radio	-	-	-	-	-	-	165	-	-
Light Tanks									
T-26 twin turret	100	950	575	1	-	-	-	-	-
T-26 single turret	-	-	616	511	553	477	-	-	957
T-26 single w/ radio	-	-	96	457	735	826	550	716	336
T-26 flame	-	-	115	430	7	10	-	290	103
T-26 bridge	-	-	1	44	20	-	-	-	-
T-26 remote control	-	-	-	-	-	-	-	55	-
Fast Tanks									
BT-2	-	396	224	-	-	-	-	-	-
BT-5 basic	-	-	761	860	-	-	-	-	-
BT-5 with radio	-	-	20	243	-	-	-	-	-
BT-7 basic	-	-	-	-	260	345	406	720	865
BT-7 with radio	-	-	-	1	240	699	222	378	478
BT-7A	-	-	-	1	-	5	149	-	-
BT-7M	-	-	-	-	-	-	-	4	-
Heavy Tanks									
T-28	-	-	41	50	32	101	39	96	131
T-35	-	-	-	10	7	15	10	11	6
Armored Cars									
FAI	-	-	676	-	-	-	-	-	-
BA-20	-	-	-	-	-	n/a	n/a	301	335
BA-6	-	-	-	-	-	n/a	n/a	n/a	-
BA-10	-	-	-	-	-	-	489	904	-

AFV Production 1931-39

outbreak of war the amphibious features were eliminated from later production to speed production. The non-amphibious vehicles were later designated T-40S, although that designation was not applied at the time.

The Russian quickly discovered what every other nation had, that amphibious capabilities, although sometimes useful, were not "free". They had to be paid for with a wide hull, thin armor, and lightweight armament. With the decision to forego the swimming features on the T-60, it seemed logical to redesign the tank to eliminate many of its shortcomings. Moscow Factory #37 once again took the lead, after realizing that it could not manufacture the more complex T-50. They used the lower hull, suspension and power pack of the T-40, but since the vehicle was not required to float, they were able to give it thicker armor, heavier armament and a lower profile. Preliminary

development took place in August 1941 and immediately orders were issued for the production of 10,000 T-60s (as they were simultaneously designated) in four factories, with two more factories added later. Nevertheless, production was sporadic due to intermittent shortages of engines and hulls and the full quantity was never built. The T-60 had excellent mobility over snow and soft ground, but was unable to keep up with T-34s cross-country, was still thinly armored and was poorly armed.

Responsibility for designing a replacement was given to Factory No.38 in late 1941. The goal was to come up with a vehicle with 45mm of frontal armor protection to protect it against the German 37mm AT guns and armed with a 45mm gun. This was achieved with the T-70, which was approved for service in March 1942. The new tank was successful in the sense that it

accomplished the stated goals, but it retained the one-man turret of the earlier light tanks, which made target engagement slow and rendered unit command from within the tank almost impossible. Efforts to remedy this problem began at Factory No.38 in 1942 and yielded the T-80 light tank, which was essentially a beefed-up T-70 with a two-man turret. By this time, however, a quandary had become apparent. In order to make a light tank effective and survivable on the battlefield, it had to approach a medium tank in complexity and the use of some components. By the time the T-80 showed up, in the autumn of 1943, the Soviets had decided that the industrial assets used to build them could be better used producing other vehicles, in particular the SU-76 assault gun, which was based on the T-70 chassis. Only a small number of T-80s were built before production of light tanks was stopped.

Medium Tanks

In October 1937 a design team at Factory 183 (Kharkov) was assigned responsibility for development of the next generation of BT wheel-track tanks, to be known as the A-20. At the same time the design team also began work on a track-only variant known as the A-32. In July and August 1939 the two prototypes were subjected to comparative field trials. Both tanks were judged to be successful. In fact, the A-32 performed sufficiently well that it was decided it could take some extra weight in the form of thicker armor. The resultant vehicle was the A-34 and the first two prototypes were delivered in January and February 1940. Even before these had been built, however, the Ministry of Defense recommended accepting the vehicle provided it passed a 2,000-km test. On 30 March 1940 the Ministry approved the vehicle, now known as the T-34, for production, but again with a proviso that pass further testing. The testing was never, in fact, completed because the slashing success of the German panzer divisions in France precipitated a near-panic among the Soviet political and military leadership. On 5 June 1940 the Central Committee passed a resolution demanding production start immediately, with Factory 183 to build 600 tanks that year, and the Stalingrad Tractor Factory (STZ) another 100.



All was not plain sailing for the T-34, however. The organization tables promulgated in early 1940 called for a mix of KV heavy tanks, T-34 medium tanks, and T-26 and BT light tanks. There were strong voices arguing that the replacement of the light tanks was at least as important as the new T-34. In fact, the Kirov plant had been ordered in 1939 to develop a new "close support" tank against that exact requirement. A prototype was delivered in 1940 and subjected to testing as the T-50, where it performed well. A second problem was that the rushed development of the T-34 had yielded a vehicle with severe mechanical problems. Although production was to continue at the two plants the new components proved difficult for the subcontractors to fabricate, the V-2 diesel being especially troublesome. As a result Factory 183 built only 115 T-34s in 1940 and STZ none at all.

Three days after the German attack, and faced with conflicting opinions the Central

Committee issued a compromise resolution on 25 June urging massive production of all three new types of tanks, the KV, the T-34 and the T-50. On 1 July a third factory, Krasnoye Sormovo, was brought into the T-34 program, but in light of continual shortages of the V-2 diesel, it was to provide its own gasoline engine for the vehicles they built. In the event, they built only 173 of the planned 750 tanks before the end of the year.

Production of T-34s was further hampered by the need to evacuate the main production facility, Factory 183, from Kharkov to east of the Urals in Nizhny Tagil. The first rail shipment of factory equipment left Kharkov on 19 September 1941 and the last Kharkov-built tank came out in early October. In December the new facility built its first 25 tanks. This was an impressive achievement but even so, it meant that for several critical months in late 1941 STZ was the only significant producer of T-34s.

In the meantime, the T-50 had been accepted

for service in April 1941 and Factory 174 (Kirov works) was directed to start mass production. In the event, the Kirov works managed to build only about 50 tanks before it was evacuated to Omsk in August 1941, where it built 14 more. In January 1942, however, production was finally cancelled. The T-50 was a capable tank, but the small size would have made upgunning from the current 45mm difficult, the Model V-4 diesel was continuing to prove very difficult to produce, and deliveries of the similar Valentine tank were beginning from Britain.

With the T-50 out of the way, the T-34 now became the tank with which the Soviet Union would win or lose the war. In June 1942 that portion of the Kirov works that had relocated to Chelyabinsk was ordered to begin production, and it delivered its first tank surprisingly quickly, on 22 August. In July Uralmash, which had been building hulls and turrets, was ordered to produce entire tanks, and their first vehicle came off the line in September. Inevitably there were minor differences between the various producers, complicating an already continual process of introducing detail improvements.

The T-34 had good maneuverability and a high level of protection for its weight, due to the well-shaped hull. Reliability problems were being largely rectified. The one area in which the tank was demonstrably weak by early 1943 was its main armament. In May 1943 the Defense Council approved an order initiating development of a tank gun with similar ballistics to the 85mm AA gun. In fact, by mid-1943 there were no fewer than four designs to choose from, with the D-5T being the first to reach fruition. An initial batch of 543 guns were built, of which about 300 were allocated to the modernized T-34, now known as the T-34/85. After this short production run the S-53 was substituted in January 1944, followed by an improved version the ZiS S-53. The 85mm gun required a larger turret, of course, and this is where the second major improvement came in. The new turret had accommodation for three men, so that a gunner could be included, removing that duty from the tank commander. As with the T-34/76, continual detail changes were made during the production run, none of which affected the performance significantly. The introduction of the T-34/85 gave the Soviet

	1940	1941	1942	1943	1944	1945 ^a
Light Tanks						
T-26	1,549	-	-	-	-	-
BT-7	706	-	-	-	-	-
T-40	41	638	-	-	-	-
T-50	-	48	15	-	-	-
T-60	-	1,385	4,660	-	-	-
T-70	-	-	4,913	3,483	-	-
Medium Tanks						
T-34/76	117	3,020	12,527	15,820	4,100	-
T-34/85	-	-	-	-	10,615	21,108
Heavy Tanks						
T-28	13	-	-	-	-	-
KV-1	141	1,258	1,860	-	-	-
KV-1S	-	-	585	621	-	-
KV-2	102	100	-	-	-	-
KV-8	-	-	102	35	-	-
KV-85	-	-	-	148	-	-
IS-1	-	-	-	67	40	-
IS-2	-	-	-	35	2,210	1,150
Self-Propelled Guns						
SU-76	-	-	26	1,908	7,155	3,552
SU-85	-	-	-	760	1,899	-
SU-100	-	-	-	-	500	1,835
SU-122	-	-	25	611	-	-
SU-152	-	-	-	704	-	-
ISU-122/152	-	-	-	35	2,510	1,530

^a January-September

Soviet Wartime Production of Tanks & SP Artillery



Union what it needed, a tank with a lethal gun, good armor protection and excellent mobility. Reliability, although improved near the end of the war, remained a shortcoming, but the huge numbers produced meant that tanks could be replaced when the engines burned out or the transmissions failed. In fact, the T-34 was produced in larger numbers than any other tank

Above: A T-34/76 of the 1st Ukrainian Front in July 1944

of the war, and if any tank can be said to have defeated the Wehrmacht, this was the one.

Heavy Tanks

The inadequacies of the antiquated yet complex T-35 were apparent long before the German invasion. In 1938 two design bureaus, OKMO and the Kotin Bureau, were tasked with developing competing heavy tank designs. The OKMO entry was the T-100, while the Kotin Bureau proposed the SMK, both twin-turret

designs with a main turret on a thick column mounting a 76mm gun, while a smaller forward turret carried a 45mm gun. Simultaneously, Kotin also began work on a single-turret heavy tank called the KV (Klimeni Voroshilov) on his own initiative. In the autumn of 1939 the three heavy tank prototypes were subjected to trials and they were transferred to the 20th Heavy Tank Brigade for the initial operations in Finland later that year for combat evaluation.

The KV proved clearly superior and, faced



with an immediate need for a modern heavy tank, the order accepting the tank for service was issued on 19 December 1939 with an initial order for 50 vehicles to be delivered in 1940. In May 1940 that number was increased to 200 even though it had undergone no extensive operational testing. The tests were finally undertaken in May and showed serious defects, mostly in the transmission. However, a production order had been signed, so work continued.

By the standards of 1940 and 1941 the KV was certainly an impressive tank. Although a mediocre performer by late war standards, the 76mm L-11 gun was lethal in the first few years, and the 75mm thick frontal armor was impervious to all tank and anti-tank guns of the time. On the other hand, at 46 tons the tank was heavy (almost inexplicably so), which limited the number of bridges it could use and stressed an already unreliable power train. For bunker-busting, a need that showed up during the 1939-40 Winter War, the KV-2 was developed, with a 152mm short-barrel howitzer in a huge turret.

Evolution of the KV continued right up to the start of the war. At the end of 1940 the L-11 gun (caliber length 23.7) was replaced by the more powerful F-32 (L/31.5) and in July by the yet more powerful F-34 (L/41.6).

Although heavily armored, the KV did prove vulnerable to the German 88mm AA gun used in the AT role, and to flanking fire from close range. The Kirov plant had begun adding additional armor plates of 25-35mm thickness on the sides as early as July 1941 and this was extended to other factories, the resultant tanks being known as KV-1e models.

During 1942 development of the KV split into two separate paths. Disillusionment was beginning to set in as regards the concept of a heavy tank that was no more heavily armed than the standard T-34/76, while sacrificing mobility for thicker (but still not invulnerable) armor. There were two obvious solutions – one to reduce the weight of the KV to improve its mobility, the other to add a larger gun that could justify its weight and restricted mobility. The first path resulted in the KV-1S, which was five tons lighter than the KV-1 as a result of reducing the armor thickness, primarily on the hull sides, and a new turret. The second yielded

the KV-85, which utilized the turret of the IS-1 tank with its 85mm gun. Although proposals to mount such a weapon on the KV went back to 1939, bickering and bureaucratic inertia prevented significant movement until the Spring of 1943. The KV-85 finally began delivery to the front in September 1943.

By that time, both the KV-1S and the KV-85 had been overtaken by events. The T-34/85 had started coming off the production line in mid-1943 as the answer to firepower plus mobility, and the IS-1 in October representing the firepower plus armor solution. Thus, both the KV-1S and the KV-85 were dropped from production after relatively short runs.

The new heavy came from the Experimental Tank Factory in Chelyabinsk, established in March 1942 with the mandate of creating a "universal tank", a heavy tank with the weight of a medium tank. Their initial efforts were concentrated on what they designated the KV-13, a 31-ton vehicle with the 76mm F-34 gun and armor superior to the KV-1 due to its better shape. Development continued in fits and starts until February 1943 when the appearance of Tiger tanks spurred a demand for the factory to build two prototypes of a "Joseph Stalin" tank based on the KV-13. In early April, after live-fire tests against a captured Tiger, the requirement was amended to include the mounting of 85mm guns. After comparative testing of several prototypes, two models were chosen for production. One was the KV-85 and the other was the IS-1, which made use of the chassis and hull developed under the KV-13 program but added a new turret with the 85mm D-5T gun.

In August 1943 the Kotin bureau suggested mounting the 122mm A-19 field gun on a lengthened version of the IS tank. The result was the IS-2 with the modified D-25T gun, and the first production model was delivered in December 1943. With the success of the IS-2, the IS-1 ceased production in January 1944 after only about a 100 had been built. The IS-2 proved a successful heavy tank, although its fortunes varied somewhat. Vulnerability of the hull front to 75mm high-velocity hits was only partially solved by redesigning the glacis plate, while the only solution available for the lower hull front was to bolt spare track sections there. The 122mm AP round also proved incapable of penetrating the front armor of the Panther and

Tiger tanks in trials in early 1944, but that problem reportedly disappeared by mid-year when the Germans began using lower-quality armor steel. In any event, the heavy tanks were concentrated in heavy tank regiments that were used mainly for infantry support, not tank-vs-tank combat. In fact, the normal basic load of an IS-2 was 10 AP and 18 HE rounds.

Assault Guns & Tank Destroyers

Design of tank killers, similar to the German StuG and Hetzer types, was begun in April 1941 and yielded several interesting designs, but the dislocation of the tank plants later that year brought development to a halt.

When the German onslaught began there were no tank destroyers in Soviet service. On 1 July 1941 the Ministry of Weapons directed that an improvised tank destroyer be designed and a prototype ready in two weeks, assigning the task to Factory 92 in Gorky. The selected model mounted the 57mm ZIS-2 anti-tank gun on the Komsomolets tractor to yield the ZIS-30 tank destroyer. The conversion was extremely simple and involved simply placing the gun and its shield on the rear cargo platform and adding two trail legs to the rear of the vehicle for stability in firing. Unfortunately, the Komsomolets tractor was taken out of production shortly thereafter in favor of tank production, so worn tractors had to be collected from field units for the conversions. In the end, 101 conversions were made. The gun was capable of knocking out any German tank of the time, but the vehicle had notable drawbacks, including the lack of a radio, poor protection for the crew, short range and instability on firing.

Early efforts to develop a self-propelled 76mm weapon came to naught, but in October 1942 the GAZ factory was ordered to try their hand at it and this was more successful. The firm took the T-70 light tank chassis, lengthened it, added another roadwheel and built up the superstructure to allow the fitting of the 76mm ZIS-3 gun as the SU-76. Improvements to the automotive components yielded the SU-76M shortly thereafter. Yet more improvements by the GAZ factory, including reducing the weight by eliminating the top and rear of the fighting compartment, yielded another version of the SU-76M given the factory designation SU-15M. Over half the



assault guns made in the USSR were SU-76s and they remained in production until the end of the war not only at GAZ, but also at Factory 30 in Kirov and Factory 40 in Mytishchi.

In addition, captured German PzKw III chassis were used to form assault guns. The turret and upper hull were removed and replaced with a box-shaped fighting compartment made of armor plate, 35mm thick at the front and 25mm at the sides, into which a 76mm ZIS-3 gun was placed. This was known as the SU-76i. Factory Number 37 built 181 assault guns plus 20 more as command vehicles with cupolas and long-range radio. They were used in combat from July 1943 until early 1944 when they were withdrawn and used for training.

A contemporary of the SU-76 was the SU-122. In April 1942 Uralmash and Factory 592 were ordered to build prototype assault guns using the 122mm M-30 howitzer. The Uralmash proposal, based on the T-34 chassis, was accepted and production started in December 1942. The vehicle proved popular in service but the appearance of the Tiger led to a demand for dedicated anti-tank vehicles, a role

for which neither the SU-76 nor the SU-122 was adequate.

Work on a variant of the SU-122 rearmed with an 85mm high-velocity gun began in May 1943 and yielded the SU-85. Their first combat usage came in September 1943 during the Dnieper crossing, and they soon became popular due to their ability to destroy any German tank of the time at respectable ranges. Nevertheless, it was clear that the Germans were moving towards tanks that were ever bigger and better protected. Thus, as early as December 1943 Uralmash was ordered to develop a new tank destroyer based on the T-34 chassis, but this time mounting the 100mm S-34 tank gun. In fact, the S-34 proved to be a failure and instead a new weapon, the 100mm D-10 was developed based on the B-34 naval gun.

The prototype ran trials in March 1944 and in the summer production of the SU-85 was ordered terminated and that of the SU-100 begun. Unfortunately, while the SU-100 was indeed ready for production, its ammunition was not. In particular, the BR-412B armor-piercing round was proving impossible to fabricate with the required specifications. By that time it was too late to restart SU-85 production so as an expedient the 85mm D-5

was installed in the completed SU-100 vehicles to yield the SU-85M. Finally, the problems with the ammunition were solved in the Autumn and in December Uralmash began installing the larger D-10.

As the Red Army began to take the offensive in late 1942 the need for a heavy assault gun began to reassert itself. Development of such a weapon based on the chassis of the KV-1S heavy tank began immediately as the KV-14, and on 14 February 1943 it was accepted for service as the SU-152. Production began in March at Chelyabinsk. The SU-152 proved very popular in service. Its 152mm HE round could demolish almost any strongpoint, and it could also fire an AP round that could knock out any German tank, although its chances of getting a hit at greater than 500-700 meters were marginal.

In fact, the vehicle proved so useful that when the KV series went out of production the concept was grafted on to the hull of its successor, the IS. The result was the ISU-152, accepted for service in the summer of 1943. Unfortunately, Soviet industry was unable to produce the 152mm ML-20S gun/howitzer in the required quantities. On the other hand, no such problems plagued the 122mm A-19 corps gun, which used the same carriage, cradle and other components as the ML-20. It was thus a simple matter to mount the A-19 in the vehicle, rearrange the internal ammunition stowage, and designate the vehicle the ISU-122. The ISU-122 was thus a completely different type of vehicle from the earlier SU-122, which mounted a howitzer. In fact, the ISU-122 made an excellent tank killer, although its main use was in the infantry support role.

Armored Cars

Given the large distances involved, it is not surprising that armored cars proved popular, both during the civil war and its aftermath. As with other countries at the time, the pre-war development of armored cars was determined largely by the availability of commercial chassis.

The first suitable chassis was the F-15, a Russian version of a Fiat 4x2 unit. The Izhorskii works developed an armored body using the turret of the MS-1 tank and the combination became known as the BA-27.

The major shift in armored car development

Above: An ISU-152 of the 2nd Baltic Front in August 1944



came with the acquisition of license production rights to the family of Ford vehicles in the late 1920s; the Model A heavy car/pickup and the Model AA 1.5-ton 4x2 truck, the latter also being enlarged slightly to yield the 6x4 GAZ-AAA 2-ton truck. The BA-27 body was dropped on to the GAZ-A (Ford A) chassis to yield the BA-27 Model 1928, but this was an interim step.

The arrival of the sturdy Ford Model A chassis and its local production as the GAZ-A in 1930 provided a sound basis for the initial family of light armored cars. The D-8 and similar D-12 were the first such vehicles, being small two man turretless vehicles armed with machine guns. Both were built in small numbers in the early 1930s. They were succeeded in production by the FAI, similar to the D-8, but featuring a small turret with a 7.62mm DT machine gun. A total of 676 FAIs were produced from 1932 to 1936, followed by 76 improved FAI-M with updated engines.

The GAZ-A chassis was somewhat overloaded by the FAI body and, when a strengthened chassis with uprated engine became available in the form of the GAZ-M1, the opportunity was taken to mount a variant of the FAI body on the new unit. The result was the BA-20, which became the standard pre-war and early war light armored car. The BA-20 had significantly better performance than the FAI, not only was the power/weight ratio improved but there was now room for a radio in a portion of the vehicles, critical for the reconnaissance role. On the other hand, its maximum armor of 6mm provided little protection, the armament of a single DT machine gun was weak, and its cross-country performance was limited by the 4x2 drive.

The heavier GAZ-AAA chassis was used as the basis for a new family of heavy armored cars. The first of these was the BA-1 with a three man crew and a turret with a 37mm gun and a coaxial DT machine gun. Only 53 were built in 1932-34 before the vehicle was replaced by the BA-3. The BA-3 was of similar configuration, with the engine at the front and an armored compartment at the rear, surmounted by a turret. In this case, however,

the turret was that of the T-26 Model 1933 tank, with its 45mm gun. Only 160 were built at the Izhorskiy plant in 1934-35 before the introduction of the next model, the BA-6.

That vehicle featured only detail improvements and is almost indistinguishable from the BA-3. In fact, the evolution of the BA-6 to the BA-6M in 1938 was more significant, for in that case the engine was uprated to give an additional 10 hp, while 300 kg was shaved from the vehicle weight to improve automotive performance. A total of 386 BA-6s (including 15-20 BA-6Ms) were built in 1936-39, again by the Izhorskiy works.

The ultimate development of the Soviet heavy armored car, and numerically the most important, was the BA-10. In common with other similar designs that relied on 6x4 truck chassis (such as the Landsverk L-180 series) the vehicles were bulky and provided with only thin armor. This disadvantage was partially offset by the provision for powerful armament for the time, but mediocre cross-country performance remained a problem. As a result production, which had begun in 1938, was terminated in 1941 after 1,400 BA-10 and BA-10M had been built.

The only example of what could be called a second-generation armored car, the BA-64, began development in July 1941 and was accepted for service in February 1942. The hull was more compact than the earlier BA-20, which allowed somewhat thicker, better-sloped

armor. The price to be paid for this, however, was a reduction in crew size to two and the absence of a radio in about half the vehicles, and the use of a less powerful radio in the others. The vehicle was also a bit top-heavy, although this was remedied with the improved BA-64B, which entered production in September 1943. The major area of improvement was in cross-country performance, resulting from the adoption of 4x4 drive in the form of the GAZ-64 "jeep" chassis. A total of 3,901 GAZ-64s were built, followed by 5,206 BA-64Bs (including some post-war production in 1946). Although cramped and poorly armed, the BA-64 proved agile, reliable and popular.

Lend Lease

Certainly the largest contribution made by the other Allies to the Soviet war machine was in the form of Lend-Lease trucks, with the US shipping close to 400,000 such vehicles, including 54,000 1.5-ton and 110,000 2.5-ton all-wheel drive models. Armored vehicles were provided in smaller numbers and were received with mixed reviews.

The British contribution, delivered under three protocol plans between October 1941 and the end of June 1944, was mainly infantry tanks, and the first Matildas and Valentines went into service in December 1941 and January 1942. Early deliveries focused on the Matilda. With its slow speed, small gun and poor performance in snow, it was not a popular



Right: A wrecked BA-10 in 1941

Protocol Period	Oct 41 - Jun 43			Jul 43 - Jun 44		
	Shipped	Lost At Sea	Arrived	Shipped	Lost At Sea	Arrived
Light Tank, Tetrarch	20	-	20	-	-	-
Infantry Tank, Matilda III	113	-	113	-	-	-
Infantry Tank, Matilda IV	915	221	694	-	-	-
Infantry Tank, Matilda IV CS	156	31	125	-	-	-
Infantry Tank, Valentine II	161	25	136	-	-	-
Infantry Tank, Valentine III	135	-	135	211	-	211
Infantry Tank, Valentine IV	520	71	449	-	-	-
Infantry Tank, Valentine V	234	113	121	106	-	106
Infantry Tank, Valentine VII ^a	1213	170	1043	175	10	165
Infantry Tank, Valentine IX	201	-	201	635	18	617
Infantry Tank, Valentine X	-	-	-	74	8	66
Infantry Tank, Churchill II	45	19	26	-	-	-
Infantry Tank, Churchill III	151	24	127	-	-	-
Infantry Tank, Churchill IV	105	-	105	-	-	-
Cruiser Tank, Cromwell IV	-	-	-	6	-	6
Bridgelayer, Valentine	-	-	-	25	-	25

^a Canadian production

British Tank Shipments to USSR October 1941 - June 1944

machine in Soviet service. The more numerous Valentine, being slightly faster, was preferred. In fact, it served largely as a light tank for scouting duties and was kept in production after 1943 solely to satisfy Soviet demand. Valentines with 6pdr guns started arriving in early 1943. An initial batch of 2pdr-armed Churchills was provided starting in May 1942, but the Red Army showed no enthusiasm for the type and there were no subsequent deliveries.

Interestingly, although the British Army rarely issued HE ammunition for its 2pdr tank guns, the British did supply such ammunition to the Red Army, with deliveries during the 3rd protocol period of 55,000 HE, 50,000 AP and 88,000 HVAP.

In addition, Britain is stated to have shipped 1,212 Universal Carriers to the Soviet Union, and Canada 1,348 more, with the loss of 224 in transit. Further, the US provided 96 similar T-16 carriers. These compared poorly with the US half-tracks in terms of general usefulness and their narrow tracks caused them to sink in snow, and as a result they were used mainly as command vehicles and sometimes, climate permitting, as a scout.

US shipments began slightly later, although by the end of 1942 1,755 M3A1 light tanks, and 1,355 M3A3 and 224 Sherman medium tanks had been shipped. With their high profile and archaic layout the M3 mediums were disliked. The diesel-engined M4A2 Sherman

proved more popular, being reliable and simple to operate. The M3 light tank was criticised, mainly for its height, in fact the tank was probably a better all-around vehicle than the T-60 and T-70 that were being built at the time.

The personnel carrier half-tracks were used mostly in the command role, while the M17 motor gun carriage with its quad .50cal mount, provided the only armored AA vehicles available in any numbers. The M3A1 scout car was used mainly for command and communications roles, but also towed anti-tank guns on occasion.

Light Tank, M3A1	1,676
Light Tank, M5	5
Light Tank, M24	2
Medium Tank, M3A3	1,386
Medium Tank, M4A2 (75mm)	2,007
Medium Tank, M4A2 (76mm)	2,095
Heavy Tank, M26	1
MGC M1A1	100
MGC M17	1,000
Tank Destroyer T48	650
Tank Destroyer, M10	52
Tank Destroyer, M18	5
Half-Track M2	342
Half-Track, M3	2
Half-Track, M5	421
Half-Track, M9	413
Carrier, T-16	96
Scout Car, M3A1	3,340
LVT	5
Recovery Vehicle, M32	115

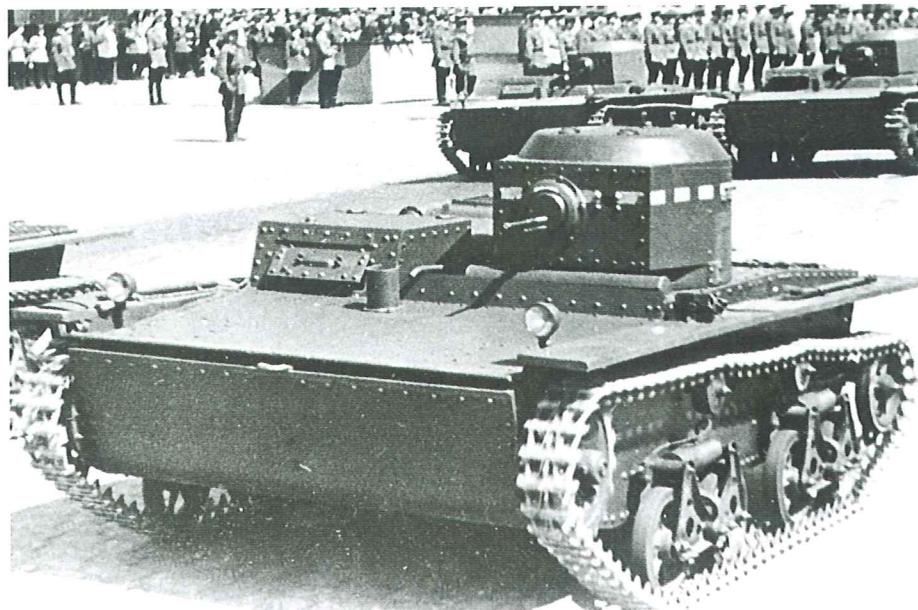
Figures include 443 M3A1 light tanks, 417 medium tanks, 54 half-tracks and 228 scout cars lost at sea during delivery

US AFV Lend Lease Shipments



Light Tank, T-37/38

The T-37 was designed as an amphibious scout tank with a two-man crew and a turret mounting a single 7.62mm DT machine gun. This evolved into the T-38, which was wider and lower than the T-37, with better swimming capability. Both models used the powertrain and engine of the GAZ-AA truck, simplifying maintenance and logistics. The T-38M2 switched to components from the GAZ-M1 truck. A propeller and rudder fitted at the rear provided movement in the water at about 6 km/h. A small number of T-38s were modified in the field to replace the DT machine gun with a 20mm ShVAK autocannon. Platoon and company commander vehicles were fitted with radios, but not the others. Their very thin armor, mandated by buoyancy requirements, and their weak armament made them ineffectual in combat, and such vehicles as were still serviceable in 1941 were quickly destroyed.

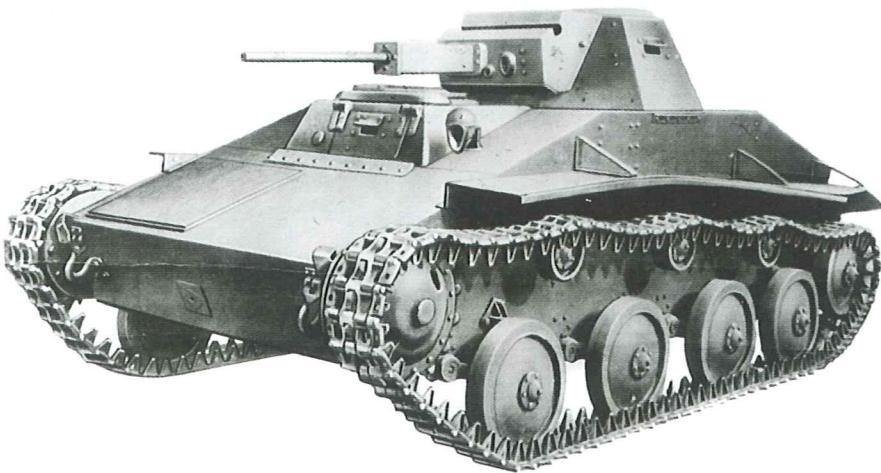


	Weight (tonnes)	3.2	Front Armor (mm)	9
	Length (m)	3.75	Side Armor (mm)	6
	Width (m)	2.10	Engine HP	40
	Height (m)	1.82	Road Speed (km/h)	35

T-38 amphibian tanks in a parade

Light Tank, T-40/60

This was the successor to the T-38, with slightly thicker armor and a much better-shaped hull. Armament was also improved, to a 12.7mm DShK heavy MG and a coaxial 7.62mm DT. Greater attention was also paid to waterborne characteristics and the T-40 performed better there than its predecessors. Starting in July 1941 the amphibious features were abandoned to yield the T-40S. The chassis, suspension and power train of the T-40 were used to create the non-amphibious T-60 light tank. Armor was thicker and it was armed with a 20mm TNSh-1 gun with 180 rounds and a coaxial 7.62mm DT. Shortages of the normal GAZ-202 engine led to other engines being installed as available, including Ford V-8s and GAZ-M. Although built in fairly large numbers, the T-60 had several significant shortcomings, including the two-man crew and, in most vehicles, the absence of a radio.



First column T-40,		Height (m)	1.95	1.74
Second column T-60		Front Armor (mm)	14	33
Weight (tonnes)	5.9	Side Armor (mm)	9	25
Length (m)	4.11	Engine HP	85	76
Width (m)	2.33	Road Speed (km/h)	44	44

T-60 Light Tank



Light Tank, T-70/80

The T-70 was a small two-man tank developed to remedy shortcomings in the T-60. It was armed with the 45mm M32/38 gun with 70 rounds and a coaxial 7.62mm DT. It was powered by two GAZ-202 (later the more powerful GAZ-203) truck engines in tandem with a common transmission mounted along the right side of the hull. As a consequence, the turret and driver positions were mounted to the left. Both armor and armament were adequate for a light tank of the time and it was built in large numbers, but the continued use of a one-man turret restricted its operational usefulness. It was succeeded in production by the T-80, which featured a two-man turret, strengthened suspension, wider track and electrical turret traverse. By this time, however, light tanks had fallen out of favor and few were built.

T-70 Light Tank

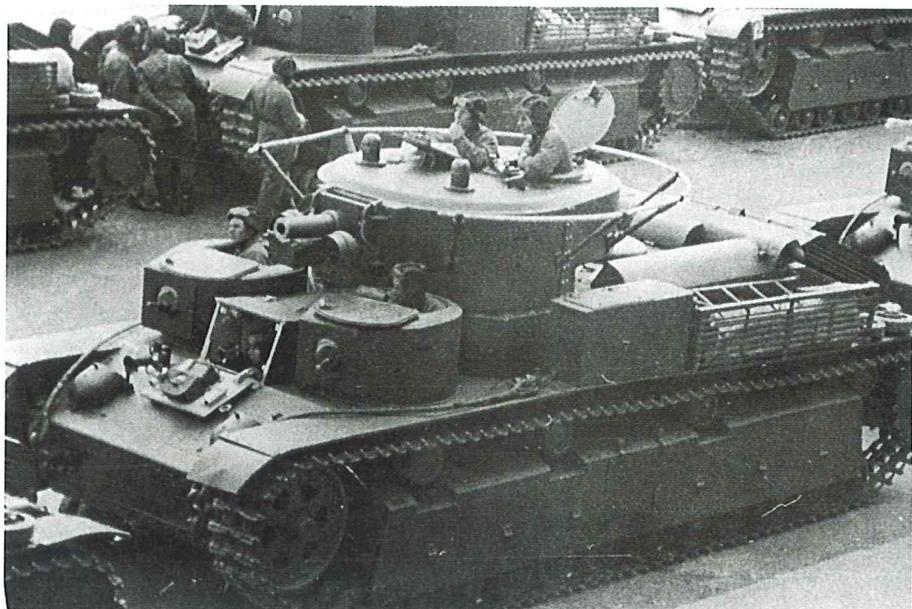


First column T-70,		Height (m)	2.03	2.18
Second column T-80		Front Armor (mm)	60	60
Weight (tonnes)	10.0	Side Armor (mm)	45	35
Length (m)	4.42	Engine HP	140	170
Width (m)	2.47	Road Speed (km/h)	45	47

Medium Tank, T-28

This tank was fitted with three turrets for a crew of six. The main turret mounted a short-barrel 76mm KT-28 gun and a forward-facing ball-mounted DT MG, along with a second DT in the rear of the turret. The other two turrets were small and mounted each side of the driver's position. Each carried a DT machine gun. In December 1938 a program was launched to retrofit the T-28 fleet with the longer 76mm L-10 gun, about two-thirds of the vehicles receiving this new weapon. When experiences in the opening phases of the Winter War showed the thin armor to be a decided weakness, a crash program was instituted to increase frontal armor to 80mm and side armor to 40mm by adding appliqué armor. In 1940 a new conic main turret was designed, but this was applied only to the few vehicles built that year. The T-28 contained some modern features, including electric turret traverse, but proved unreliable in service.

T-28 heavy tank in the 1939 May Day parade



	Weight (tonnes)	27.8	Front Armor (mm)	30
	Length (m)	7.44	Side Armor (mm)	20
	Width (m)	2.81	Engine HP	500
	Height (m)	2.82	Road Speed (km/h)	45



Medium Tank T-34

All models of the T-34 used a variation of the Christie suspension, but with torsion bars in lieu of the large springs that featured so prominently on the original. There were two main groupings of this tank, the initial model T-34 (subsequently redesignated the T-34/76) and the later T-34/85, each with a number of subvariants.

The T-34/76 Model 1940 featured a welded two-man turret that mounted a 76mm L-11 Model 38/39 gun (caliber length 23.7) with a coaxial 7.62mm DT machine gun. In the turret were situated the commander (doubling as gunner) and the loader. The rear half of the turret roof was hinged to fold forward into an upright position, thus blocking the view of the commander when he rode with his head out. The two other crewmen, the driver and the assistant driver, sat at the front, the assistant being provided with a ball-mounted DT. In command tanks, the only ones with a radio, the assistant also acted as the radioman. Following the completion of about 400 Model 1940s production switched to the Model 1941, which featured the more powerful F-34 (L/41.5) 76mm gun. Detail changes resulted in the Models 1942 and 1943. In August 1942 an improved hexagonal turret was introduced with two circular hatches in lieu of one large one, and in the summer of 1943 a commander's cupola was introduced. Radios were fitted to an increasing percentage of tanks until all were so equipped, starting in 1943.

The T-34/85 utilized the hull and automotive components of the earlier 76mm versions, but fitted with a new turret. The new turret incorporated two major improvements. The first was that it accommodated three men, so the commander no longer doubled as the gunner. The second was the replacement of the F-34 gun with an 85mm gun (the Model D5-T on the first 300, the S-53 or ZiS S-53 on later vehicles).

The early models suffered from unreliable engines and clutches that limited their usefulness. These problems were mostly ironed out in later versions and the T-34 became one of the best tanks of the war.

First column T-34/76 M41,
Second column T-34/85

	First column T-34/76 M41	Second column T-34/85
Weight (tonnes)	26.5	32.0
Length (m)	6.68	8.15
Width (m)	3.00	3.00
Height (m)	2.45	2.60
Front Armor (mm)	52	90
Side Armor (mm)	52	75
Engine HP	500	500
Road Speed (km/h)	53	55



Top: A T-34/76 Model 1941 advancing in 1942

Middle: Another Model 1941 at speed in 1942

Bottom: A T-34/85 resting at Aberdeen Proving Ground in 1978

Fast Tank BT

The original BT-2 was the US wheel/track Christie Model 1930 tank with a new one-man turret, usually with machine gun armament. The BT-5 was similar, but was fitted with a two man turret with the 45mm M32 gun and a coaxial DT MG. A more substantive redesign was undertaken to yield the main production variant, the BT-7. Although hampered by a two-man turret and relatively heavy armor, the BT-5/7 series was fast and possessed a powerful armament. The ability to move long distances by wheel was shown during the 1939 fighting against the Japanese. By the time it was called on for its greatest test in 1941, it was dated and the victim of poor Soviet maintenance practices.



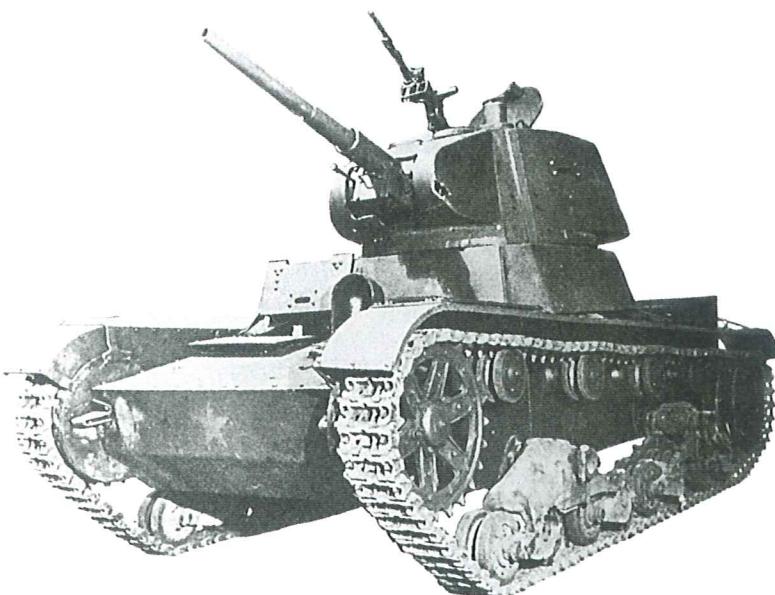
BT-7 Light Tank

First column BT-5,			Height (m)	2.24	2.42
Second column BT-7			Front Armor (mm)	15	20
Weight (tonnes)	11.9	13.8	Side Armor (mm)	10	15
Length (m)	5.80	5.66	Engine HP	365	450
Width (m)	2.23	2.23	Road Speed (km/h)	53	50

Infantry Tank T-26

This tank came in two main variants. The Model 1931 featured side-by-side turrets, each with a 7.62mm DT machine gun, although a command version substituted a 37mm gun in the left turret. The Model 1933 had a single turret armed with a 45mm Model 1932 20K tank gun and a coaxial DT. The Model 1933 went through many changes, including the adoption of welding and the placement of a second DT in the turret rear. The Model 1938 used the improved M1938 main gun. The speed was too slow for any but the infantry support role while the armor too thin for that mission, and the two-man turret crew was inefficient. As a result the vehicle was not popular with its crews. Nevertheless, it had a good gun for its time and, on paper, was the equal of the PzKw IIIs sent into Russia in 1941. It was the most numerous tank in the Soviet Army in June 1941.

T-26 Model 33 light infantry tank

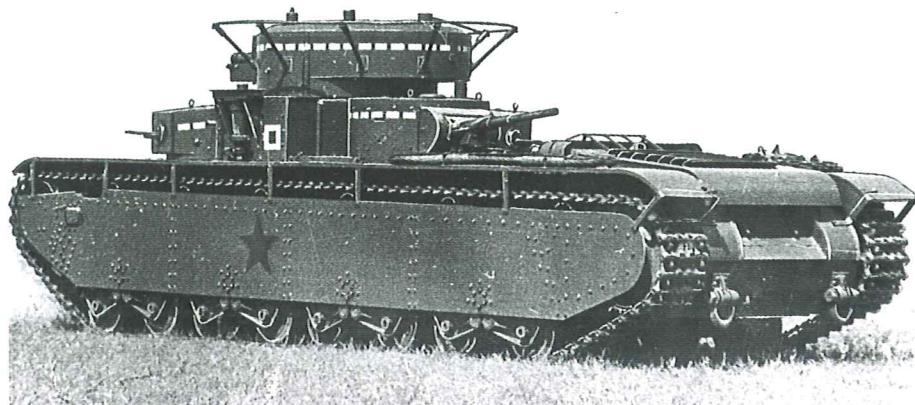


	Weight (tonnes)	9.4	Front Armor (mm)	15
	Length (m)	4.62	Side Armor (mm)	15
	Width (m)	2.44	Engine HP	90
	Height (m)	2.24	Road Speed (km/h)	35



Heavy Tank T-35

Visually very impressive, the massive T-35 sported no less than five turrets. The main central turret was identical to that of the T-28, as were the two MG turrets at the left front and right rear. The other two turrets each carried a 45mm Model 20K gun and a coaxial MG. The tank required a crew of ten, including three in the main turret and two in each 45mm turret. Although massive from the outside, inside the tank was cramped and inefficient. Unlike the T-28s, it would seem that the T-35s were never rearmed with the longer L-10 76mm gun. By 1939 it was clear their armor was too thin for a heavy tank, but the suspension was already overloaded so no improvement could be made there either. In the end it was their mechanical unreliability, however, that doomed them when they first saw combat in 1941, most being abandoned after breaking down.



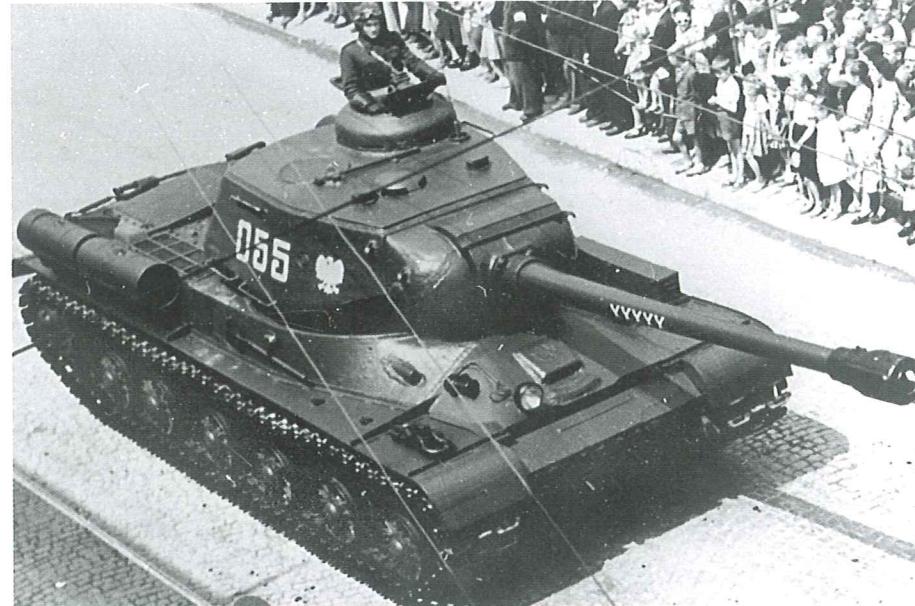
The 5-turreted T-35 heavy tank

	Weight (tonnes)	50.0	Front Armor (mm)	30
Length (m)	9.72	Side Armor (mm)	30	
Width (m)	3.20	Engine HP	500	
Height (m)	3.43	Road Speed (km/h)	30	

Heavy Tank IS

The initial model, the IS-1 featured an 85mm D-5T gun, but was almost immediately superceded in production by the IS-2. The IS tanks used a cast turret and cast or welded hulls that significantly reduced the profile of the tank while increasing armor protection.

Nevertheless, the front hull armor still proved vulnerable to large-caliber hits and in May-June 1944 production was switched to a design with a straight glacis plate rather than the stepped one previously used. The lower hull front, however, could not be altered. Armament consisted of the 122mm D-25T gun, along with a coaxial DT machine gun and a second DT in the turret rear. A DShK 12.7mm MG was AA mounted on the commander's cupola starting in May 1944. The main drawbacks were caused by the large, separately-loaded ammunition. These slowed the rate of fire to about 2 rounds per minute, and ammunition stowage to 28 rounds.



	Weight (tonnes)	46.1	Front Armor (mm)	160
Length (m)	9.83	Side Armor (mm)	110	
Width (m)	3.07	Engine HP	600	
Height (m)	2.74	Road Speed (km/h)	37	

IS-II heavy tank

Heavy Tank KV

The KV (later KV-1) was the modern successor to the archaic T-35. The initial model KV-1 M1939 featured the medium-velocity L-11 76mm gun and two DT machine guns, one facing rear, in a three-man turret. In this case the commander doubled as the loader (the third crewman was a rear machine gunner), and it is unclear whether asking the commander to do loader duties was any better or worse than the T-34/76 arrangement of tasking him as the gunner. A third DT was placed in a ball mount in the hull front, where it was operated by the co-driver/radio operator. The Model 1940 replaced the main gun with the longer F-32 and used the more powerful V-2K diesel starting in late 1940. In July 1941 production changed to the Model 1941, with the F-34 gun in a new cast turret with thicker armor. Appliqué armor was fitted to about a quarter of the tanks starting in the Spring of 1941, yielding the KV-1E. A flame-thrower version of the KV-1 was produced as the KV-8, in which an ATO-41 flame-thrower replaced the coaxial MG, and a 45mm M32 gun replaced the 76mm for space.

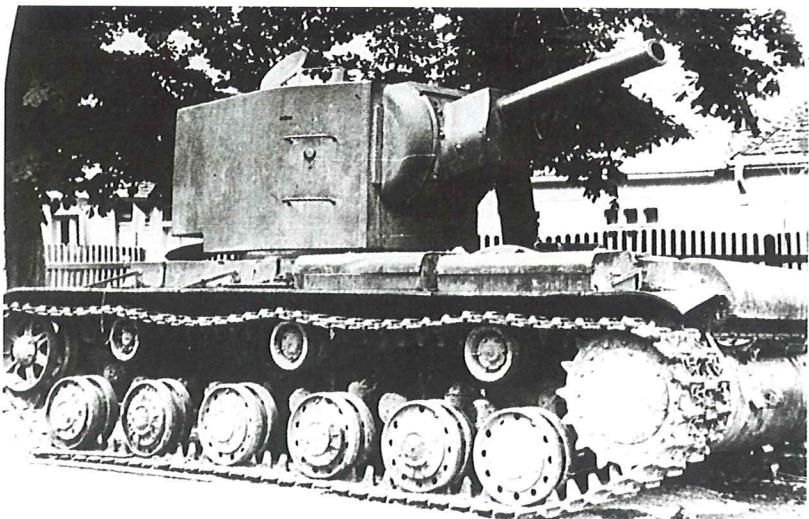
The KV-2 was a contemporary of the KV-1 and shared the same hull and automotive components, but was fitted with a huge turret that mounted a shorted version of the 152mm M-10 Model 1938/40 howitzer. The only ammunition available was the HE projectile with a reduced propellant charge. It was a single-purpose weapon, designed for the direct-fire destruction of pillboxes and other fortifications and was not built in large numbers.

The KV-1S was a redesigned KV-1 with thinner armor, reducing the weight by 5 tons, and a new transmission, and consequently greater mobility. It also received a new turret with a commander's cupola and either the ZIS-5 or F-34 76mm gun.

The KV-85 used the hull and automotive components of the KV-1S carrying the turret of the IS-85 with the 85mm D-5T gun. The hull MG and the radioman who operated it were removed to make room for ammunition.

First column KV-1,
Second column KV-2,
Third column KV-1S

	Weight (tonnes)	52.0	42.5
	Length (m)	6.90	6.90
	Width (m)	3.32	3.35
	Height (m)	2.71	3.25
Front Armor (mm)	75	110	75
Side Armor (mm)	75	75	75
Engine HP	600	600	600
Road Speed (km/h)	35	35	43



Top: The KV-1 of the Aberdeen collection from the front

Middle: The KV-1 from the rear

Bottom: The massive turret and huge gun of the KV-2 made it visually very distinctive



Assault Gun SU-76

There were several versions of the SU-76, all based on the lengthened chassis of the T-70 chassis. The first version, also known by its factory designation SU-12, had two GAZ-202 engines, one each side of the driver and an enclosed fighting compartment made of 10mm armor at the rear mounting the 76mm ZIS-3Sh gun. The automotive components proved unreliable and after 350 vehicles production was switched to the SU-76M with improved clutches and engine mounts that reduced, but did not eliminate, the troubles. From 1 October 1943 a revised design was produced that eliminated the top and rear of the fighting compartment to save weight and further improved the power train. This carried the factory designation SU-15M and was the most numerous variant. The SU-76 was cheap and easy to produce and with low ground pressure it had good mobility over soft terrain. It proved very useful in the infantry support role, although its light armor made it very vulnerable as an anti-tank weapon.



Above: SU-76 assault gun

Below: Interior of an SU-76M, without overhead armor. Gunner (left), Loader (center), Commander (right)



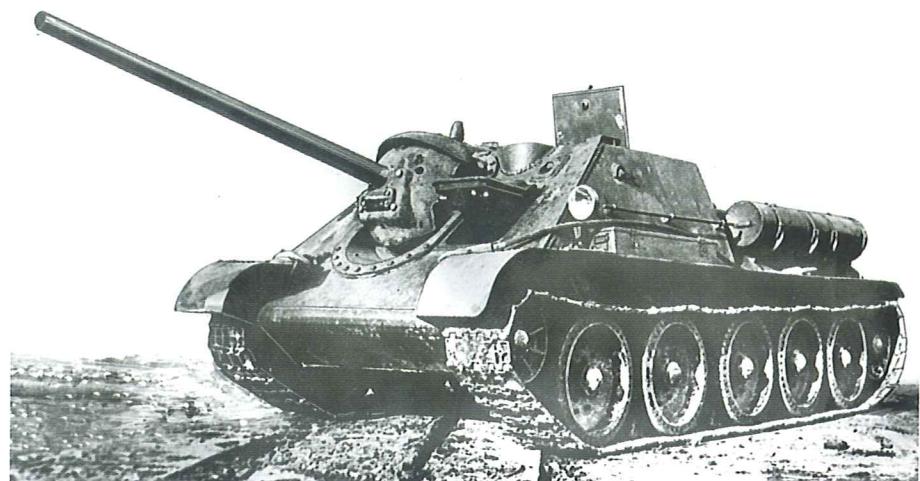
Weight (tonnes)	11.2	Front Armor (mm)	35
Length (m)	5.00	Side Armor (mm)	16
Width (m)	2.74	Engine HP	140
Height (m)	2.20	Road Speed (km/h)	44



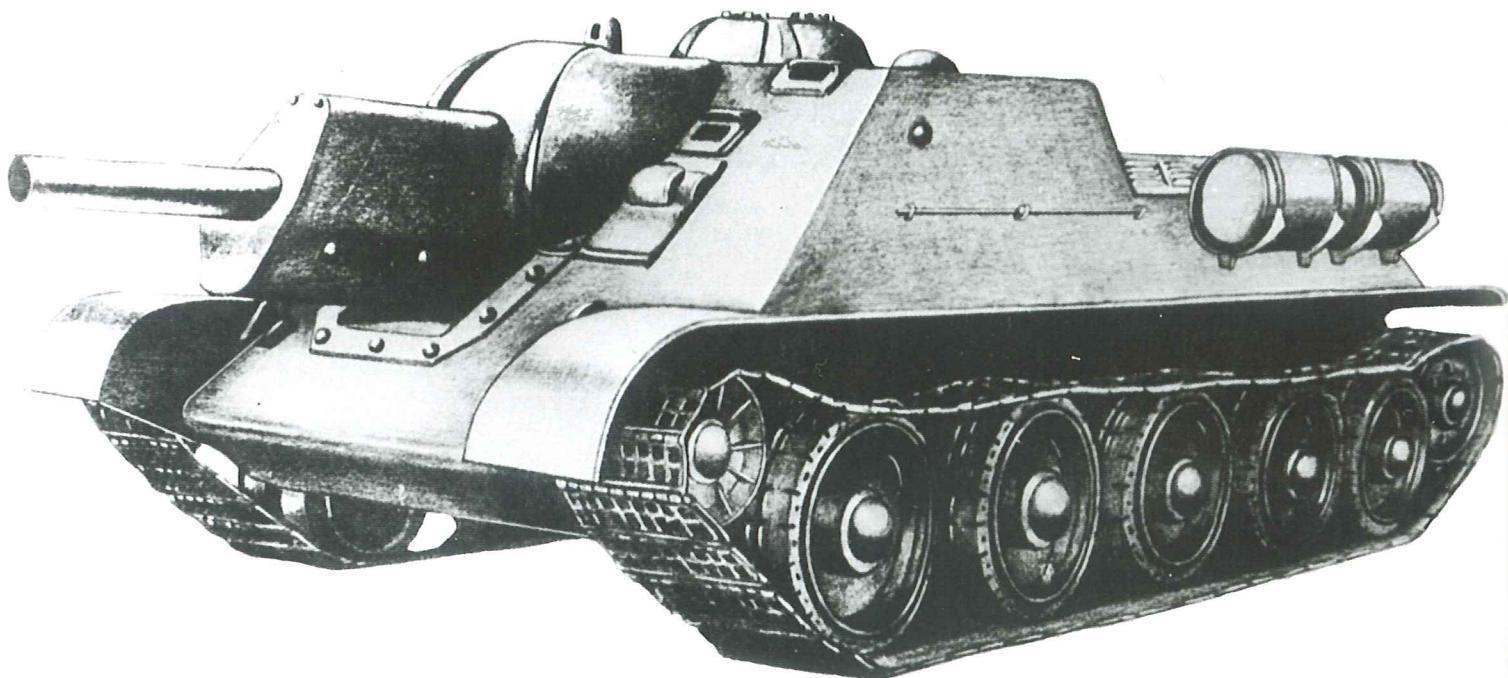
Assault Gun SU-85/122

The SU-122 took the hull of the T-34 and added a raised superstructure into which was fitted the 122mm M-30 howitzer. The weapon could elevate from -3° to $+26^\circ$ and traverse 10° each side of center. The crew of five consisted of a driver and gunner (behind him) on the left, commander at the right front, and two loaders at the rear to handle the separately loaded ammunition. Forty rounds were carried for the howitzer. It was replaced in production by the SU-85, which substituted the 85mm D-5S gun (with 48 rounds) for the howitzer, turning it into an efficient tank-killer. One of the loaders was dispensed with at the same time. The SU-85M was an expedient mounting the D-5S gun on the hull of the SU-100. The larger hull allowed the carriage of 60 rounds of ammunition. None of the vehicles mounted a machine gun.

Above: SU-85 tank destroyer
Below: An SU-122 assault gun



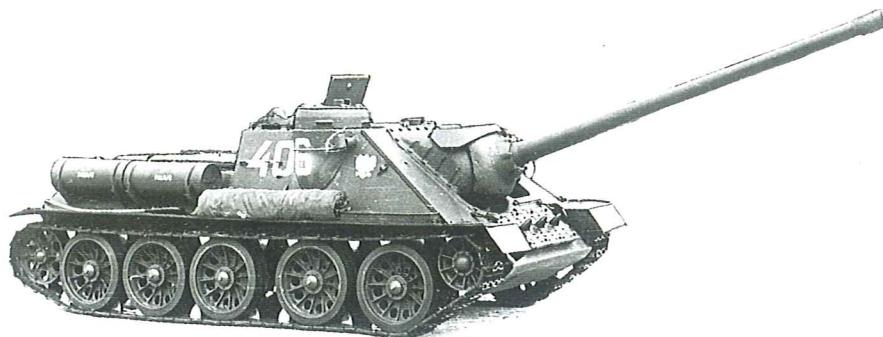
First column SU-85,		Height (m)	2.45	2.32
Second column SU-122		Front Armor (mm)	45	45
Weight (tonnes)	29.2	Side Armor (mm)	45	45
Length (m)	8.15	Engine HP	500	500
Width (m)	3.00	Road Speed (km/h)	55	55





Tank Destroyer SU-100

The SU-100 was developed to mount the 100mm D-10 gun on the chassis of the T-34 tank. It was similar, but not identical, to the SU-85 and SU-122 that preceded it. The hull was slightly roomier to accommodate the larger gun and the tank commander's position was moved towards the outside, with a pulpit-style cupola projecting from the side of the vehicle. The vehicle housed a crew of five and 34 rounds of ammunition. It had no secondary machine gun armament. The SU-100 was quite nose-heavy due to the large gun and the limited ammunition stowage could be a tactical disadvantage. However, it was a very efficient tank killer, with a powerful gun and good armor protection.



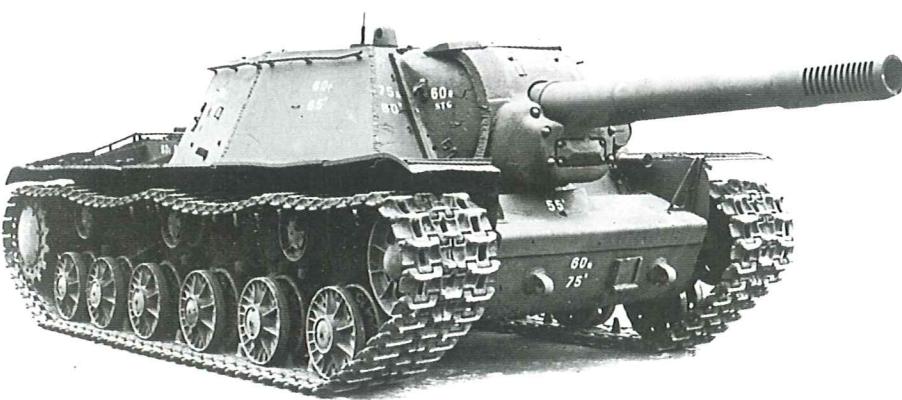
The SU-100 showing its characteristic long barrel



Weight (tonnes)	31.6	Front Armor (mm)	45
Length (m)	9.45	Side Armor (mm)	45
Width (m)	3.00	Engine HP	500
Height (m)	2.25	Road Speed (km/h)	48

Assault Gun SU-152

This vehicle was based on the chassis of the KV-1S heavy tank. A short superstructure was built on the hull and used to house the 152mm ML-20 gun/howitzer. The vehicle was equipped with both a panoramic sight for indirect fire and a telescopic sight for direct fire, although the latter was the more common usage. The gun could traverse 12° and could elevate from -5° to +18°. Ammunition was separate-loading, which limited the practical rate of fire to about two per minute, and 20 rounds were carried. Both AP and HE rounds were available. No secondary armament was initially fitted, but a 12.7mm DShK machine gun on an AA mount was added during the production run. The SU-152, with its massive HE shell, was a fearsome infantry support vehicle. It could also be used as a tank destroyer, although the curved trajectory of the projectiles made accuracy less than optimal for that role.



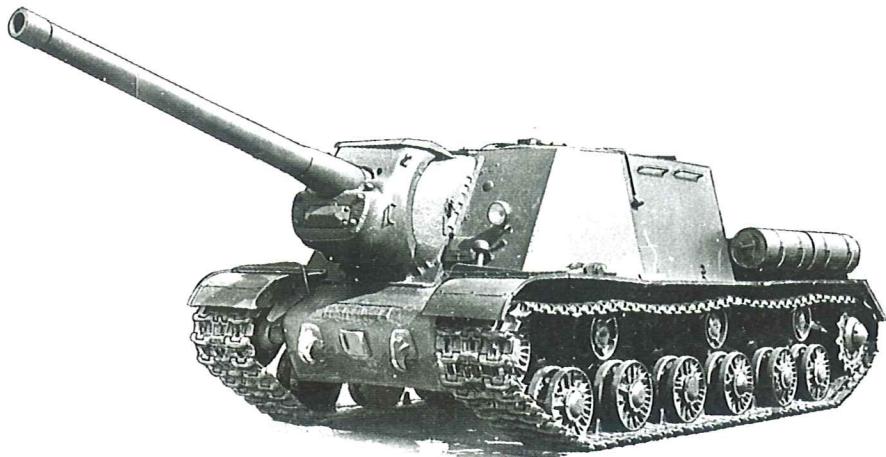
Weight (tonnes)	45.5	Front Armor (mm)	60
Length (m)	8.95	Side Armor (mm)	60
Width (m)	3.25	Engine HP	600
Height (m)	2.45	Road Speed (km/h)	43

SU-152 heavy assault gun

Assault Guns ISU-122/152

The original vehicle, the ISU-152, was simply the concept of the SU-152 moved to the chassis of the IS-1 tank. The fighting compartment was slightly taller than on the SU-152. The armor was thicker but the ammunition load the same. Traverse was 10° each side and the maximum elevation gained an extra 2° due to higher trunnion mountings. The ISU-122 was identical but substituted the 122mm A-19 gun for the 152mm weapon. The A-19 was modified with a semi-automatic breech block and redesignated the D-25S and when this was fitted in lieu of the A-19 the rate of fire increased from 1.5 to 3 rounds per minute and the vehicle was designated the ISU-122S. The ISU-152 carried 20 rounds and the ISU-122 30 rounds of ammunition. Both had provision for a 12.7mm DShK AA machine gun. Both were employed very effectively as infantry support vehicles, although the powerful gun of the ISU-122 made it an excellent long-range tank killer as well.

ISU-122



First column ISU-122,		Height (m)	2.48	2.48
Second column ISU-152		Front Armor (mm)	90	90
Weight (tonnes)	45.5	Side Armor (mm)	90	90
Length (m)	9.85	Engine HP	600	600
Width (m)	3.07	Road Speed (km/h)	37	37

Armored Car, BA-20

The standard light armored car of the pre-war and early-war years, the BA-20 was based on the GAZ-M1 car/pickup chassis. The normal vehicle had a crew of two: driver and commander/gunner, with the latter in a small turret fitted with a ball-mount 7.62mm DT machine gun. Command vehicles were fitted with a radio and a seat for a third crewman to operate it. The BA-20 was little more than an armored body on a civilian car chassis, and its thin armor, poor armament and 4x2 drive limited its usefulness. On the other hand, it was fast on the roads, reliable and available in large numbers. The BA-20M featured greater fuel stowage and a radio (and third crewman) in all vehicles, improving its utility for the reconnaissance role.



	Weight (tonnes)	2.5	Front Armor (mm)	6
	Length (m)	4.31	Side Armor (mm)	6
	Width (m)	1.75	Engine HP	50
	Height (m)	2.13	Road Speed (km/h)	85

Radio-equipped BA-20s in the 1939 May Day parade



Armored Car, BA-64

The BA-64 was in the same weight category as the earlier BA-20 but was smaller, which permitted the use of thicker armor. In addition, it used multi-faceted armor plates that further increased its protection. Equally important, it switched to a military 4x4 chassis that improved cross-country performance. Crew size, however, had to be reduced to two. The only armament, a DT machine gun, was pintle-mounted to the floor and the gunner/commander provided with a small open-top turret that rotated with the gun. The BA-64B was similar, but featured a wider wheel track that significantly improved cross-country performance of the top-heavy vehicle, and other detail improvements. As a field expedient small numbers of vehicles had their turrets removed and a PTRS anti-tank rifle installed. About half of the BA-64 and BA-64B fleet were fitted with RP radios, less powerful than the 71-TK models used in the BA-20.

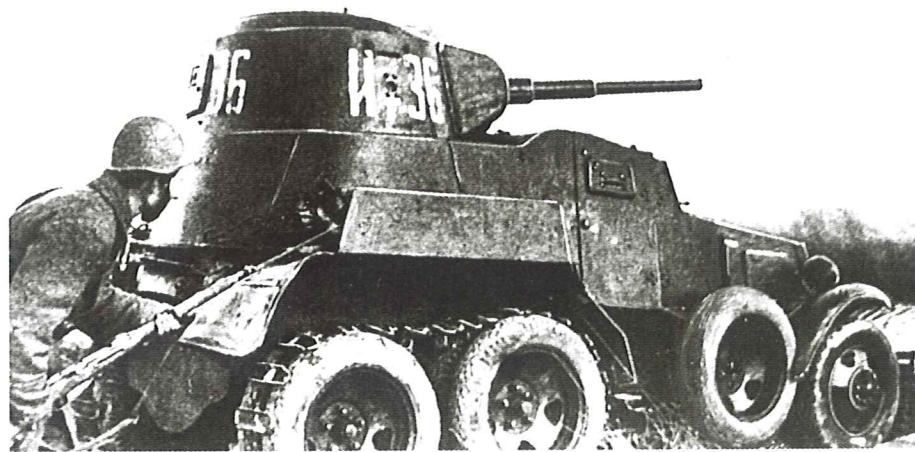
A BA-64 of the Polish Army in the East



	Weight (tonnes)	2.4	Front Armor (mm)	12
	Length (m)	3.67	Side Armor (mm)	12
	Width (m)	1.52	Engine HP	50
	Height (m)	1.88	Road Speed (km/h)	80

Armored Car, BA-10

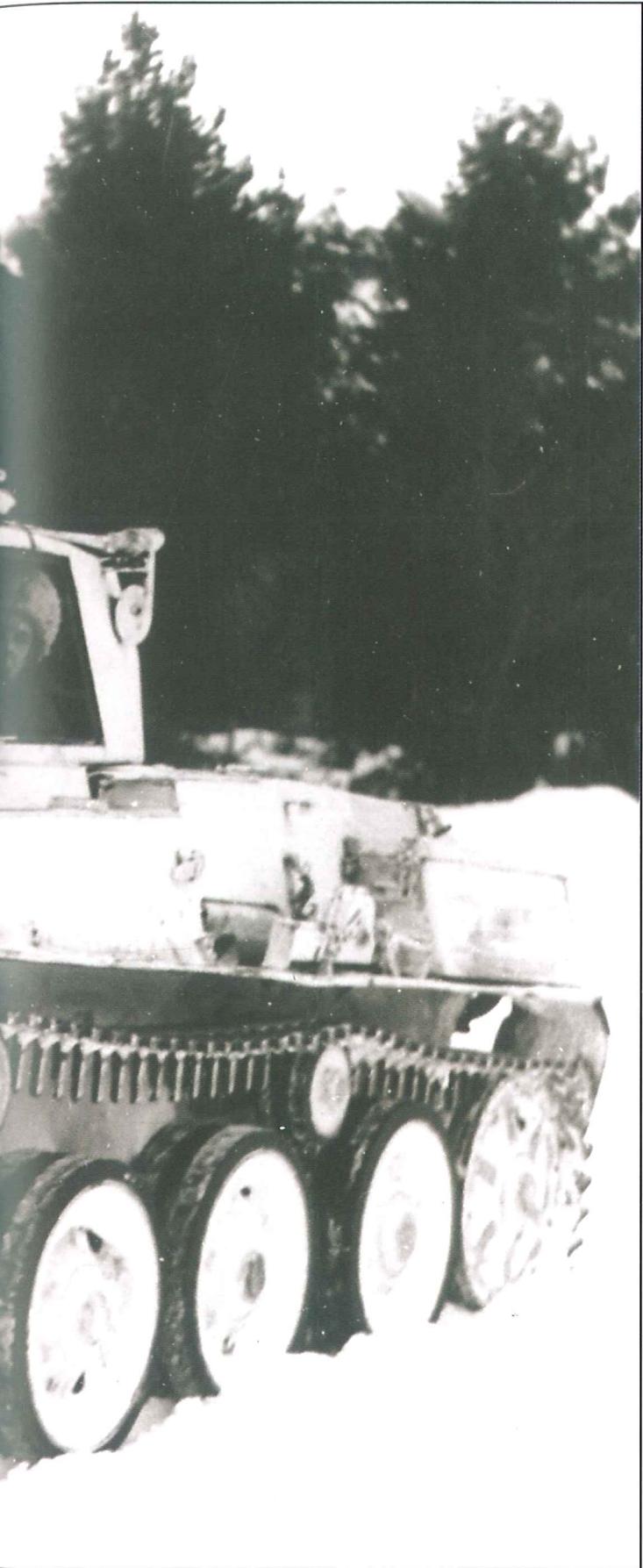
This vehicle was a minor modification of the earlier BA-6M and used the same configuration: the engine at the front, driver and hull gunner in the center, and fighting compartment with turret to the rear. Main armament was the 45mm M1938 gun, with an elevation of -2° to $+20^\circ$ and for which 43 rounds were carried. Secondary armament was a DT machine gun coaxial with the main gun and a second DT in the hull front. Firepower was impressive for its time and a radio was standard equipment, but the 6x4 drive limited cross-country mobility and the armor was quite thin. "Overall tracks" could be fitted around the rear wheel pairs, turning the vehicle into a half-track, but this reduced road speed until the vehicle could be stopped and tracks removed. The BA-10M featured detail changes, including slightly greater fuel stowage.



	Weight (tonnes)	5.1	Front Armor (mm)	10
	Length (m)	4.66	Side Armor (mm)	10
	Width (m)	2.07	Engine HP	52
	Height (m)	2.21	Road Speed (km/h)	53

A BA-10 advancing in 1941 with "overall tracks" fitted





Sweden

The success of tanks in the First World War had not escaped Swedish notice and in the summer of 1920 a delegation visited Germany where they located ten LK-I light tanks that had been almost completed by the war's end. These they purchased for SEK 18,000 each and shipped back to Sweden in pieces labelled "agricultural machinery". Arriving in August/September 1921, they were reassembled as the fm/22 tank, the first in Swedish service. A single example of the Renault NC-27 was purchased in 1928 as the fm/28, but it proved disappointing in trials. Instead, as an interim measure, five of the fm/22 tanks were modernized with new engines and machine guns during 1930-34 as the fm/21-29, while the other five were allowed to run down and were cannibalized for spares.

Of greater significance was the development of an indigenous design and production capacity. Denied tanks by the peace treaty, Germany began clandestine efforts to maintain their design capability through foreign intermediaries. Of particular note, the firm of Gutehoffnungshutte Oberhausen A.G., through a Dutch subsidiary, purchased the Swedish engineering firm Landsverk. The extent of German participation in the actual design work is unclear, but by 1930 a firm with no previous experience in armored vehicles was designing and producing tanks as advanced as any in the world.

Landsverk presented two new tanks in 1930, a wheel-track combination vehicle known as the L-30 and a tracked-only version as the L-10. Both had a crew of three, were fast for their time (40 km/hr for the L-10) and mounted a 37mm Bofors gun with two machine guns. The Army purchased one L-30, which they designated the fm/31, and three L-10s, which became the m/31. Although advanced, the L-30 suffered from the complexity that plagued similar designs around the world and was not proceeded with. The L-10, on the other hand, was further developed into a series of very successful light tanks.

By the mid-1930s it was becoming clear that the first-line tank strength of three m/31 and five m/21-29 was hardly sufficient. The tanks were concentrated in a much-understrength tank "battalion", initially under the Svea Livgarde infantry regiment and from 1928 under the Göta Livgardes. The war plans called for the mobilization of the Swedish Army into two corps, and it was felt necessary to field a tank battalion for the support of each.



On 11 June 1936 the Swedish parliament appropriated SEK4.5 million for the purchase of one battalion-set of tanks and the Army staff asked Vickers and Landsverk for proposals. Landsverk responded with their L-60, an improved model of the L-10. Negative reports from Finland on the Vickers 6-ton tank led to the elimination of that firm from consideration, and the Swedes turned their attention to CKD of Czechoslovakia.

The limited funds did not allow the purchase of a battalion's worth of cannon-armed tanks, so a compromise was reached. The AV-IV tankette from CKD was selected and modified to Swedish standards as the most numerous vehicle. A contract for 48 vehicles was placed in July 1937 for delivery in parts to Jungner in Oskarshamn, where they were fitted with Volvo engines and locally-made armor plating from Avesta. In September a contract for SEK2

million was placed with Landsverk for 16 of their L-60 tanks. Deliveries to Sweden of the AH-IV components were completed in November 1938 and both models of tank were delivered to the Army in 1939. In service the CKD vehicles were designated the m/37 and the L-60s the m/38.

With the deliveries of these tanks the Göta Livgardes regiment was finally able to field a full tank battalion consisting of four companies (each with three 3-tank platoons of m/37s, one platoon of three m/38s, with three m/37s and an m/38 as command and reserve vehicles). When the war broke out in September 1939 the need for a second tank battalion became acute. In fact, of course, there were tanks for only one battalion and the inexplicable decision was made to disband Göta Livgardes and split the battalion into two. Thus, from October 1939 the Södermans regiment was responsible for the bulk of the tank battalion (HQ and two companies), with the Skaraborgs regiment responsible for the 3rd Company. The

elimination of the fourth tank company made it possible to increase platoon size to five tanks, although at the expense of the command and reserve tanks as well. The objective, presumably, was to give two units experience in tanks.

The outbreak of the war also loosened purse-strings and on 19 December 1939 an order was placed with Landsverk for twenty improved L-60s, to be known as the m/39. According to the contract, these were to be delivered by October 1940, but delays in gun production by Bofors meant that actual deliveries stretched into 1941. By this time the L-60 design was starting to show its age. The two-man turret and thin armor rendered it unsuitable as a main combat tank, so again the Swedes turned to CKD. Further, Swedish war industries were starting to show signs of reaching capacity.

By this time the Germans had taken over the Czech region, including CKD. Nevertheless, negotiations proceeded for the sale of 90 TNH tanks and a contract was signed in late 1939 for delivery in 1940. After contract signing,

Above: An m/37 in Gotland



however, the Germans had second thoughts and initially delayed delivery and then took over the tanks themselves. Instead, Germany permitted CKD to sell a production license to Sweden and a prototype in mild steel was delivered in June 1941.

Temporarily left in the lurch by the German about-face, the Army turned once again to Landsverk. In November 1940 a contract was placed with the firm for 100 more L-60s, modified again, this time with an automatic transmission, known as the m/40. Finally, in the autumn of 1941 a contract was placed with Scania-Vabis for 116 TNH tanks, with local engines, for delivery the following year. For all this effort, however, it was clear that the days of a 10-ton tank armed with a 37mm gun were numbered. In mid-1941 the Army's tank committee recommended the adoption of a 20-ton tank armed with a 75mm gun, but recommended against adopting a foreign design. Fortunately, Landsverk had been working on an enlarged version of their L-30

design, known as the Lago, with an eye towards the Hungarian market. A provisional order for 100 was placed in November 1941 and confirmed, with an additional 60 vehicles, in January 1942. Because Landsverk was now fully booked up, the last 60 were license-built by Volvo.

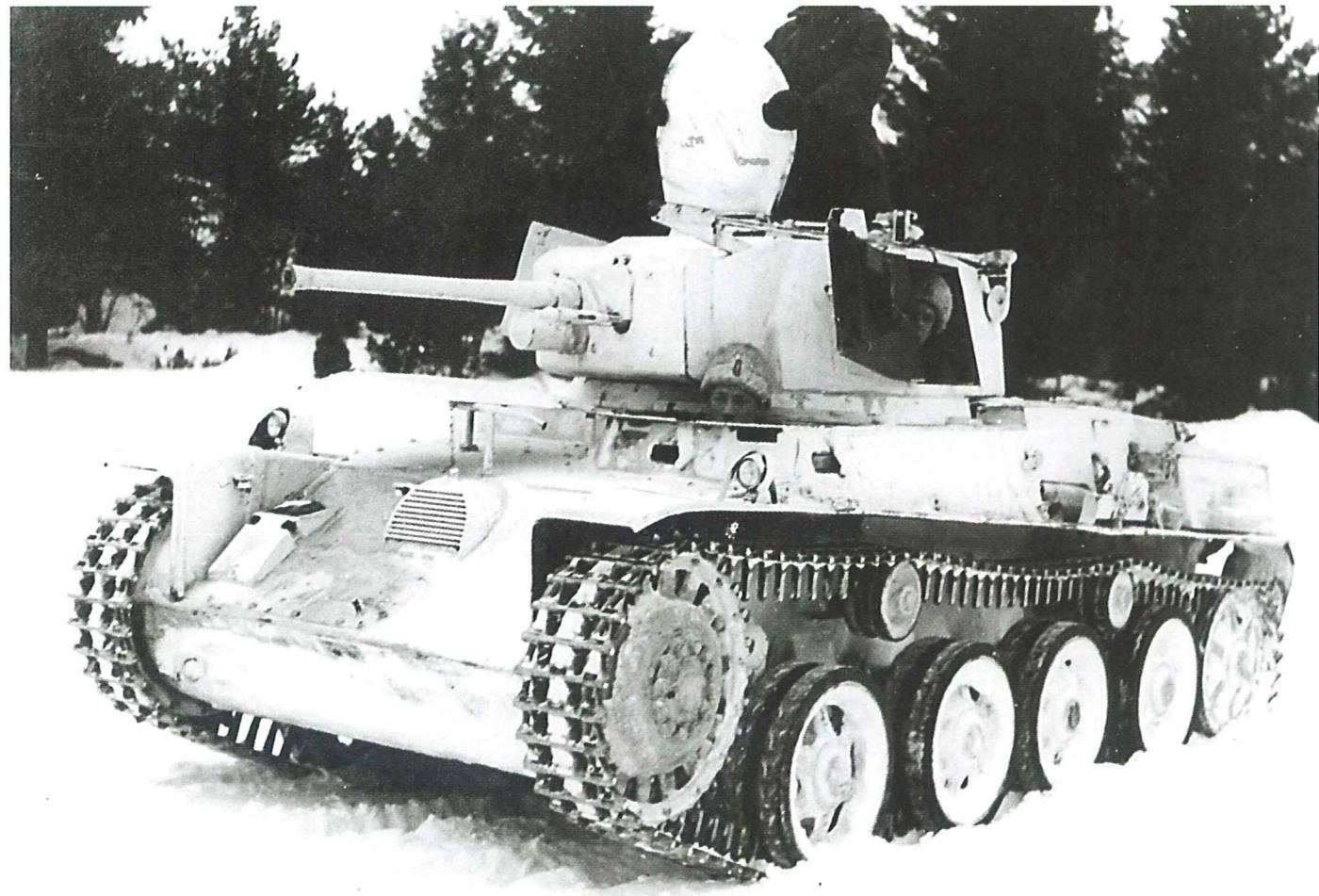
The decision in 1942 to create armored brigades in 1943 expanded the tank requirement. An additional 202 10-ton tanks (to be called light tanks for the first time) would be needed, along with over 250 medium tanks with 75mm guns. Thus, orders were placed for an additional 84 m/40s license-built by Karlstads Mekaniska Verstad and 122 m/41s from Scania-Vabis (although 18 of the m/41s were actually completed as assault guns). The m/41s were to a modified design known as the m/41 S-II, with a more powerful engine and slightly redesigned turret. Finally, a provisional order placed in June 1942 for an additional 80 m/42s from Landsverk was confirmed in early 1943 and another 42 ordered from Volvo.

Below: An m/38 in winter white camouflage (KAS)

These contracts permitted the conversion of three regiments (Skaraborgs and Södermanlands infantry and Skånska cavalry) to tank units and the reactivation of the Göta Livgardes as a tank regiment. Combined, they formed the basis for three armored brigades on mobilization, with each brigade containing two tank battalions. Each of these battalions consisted of three light companies (each 18 light and 5 m/42 tanks) and a heavy company (18 m/42s). By this time the m/37s had been relegated to a special company on Gotland, while the m/38s were held in depot reserve.

Landsverk was also active in the export arena, with mixed success. In 1936 the Hungarians purchased an L-60, and after testing, and a few modifications, it was adopted for local production as the Toldi, with Sweden providing some components for the first series of 80.

In addition, Landsverk was an early believer





JANE'S TANKS OF WORLD WAR II

	1937	1938	1939	1940	1941	1942	1943	1944	1945
m/37	-	-	48	-	-	-	-	-	-
m/38	-	-	16	-	-	-	-	-	-
m/39	-	-	-	-	20	-	-	-	-
m/40	-	-	-	-	-	100	-	80	-
m/41	-	-	-	-	-	-	-	220	-
m/42	-	-	-	-	-	-	-	282	-

Swedish Tank Production

in the need for anti-aircraft tanks. A slightly smaller version of the L-60 with a 20mm AA gun, known as the L-120, was built in prototype form, but attracted no official interest. A lengthened version of the L-60 with a Bofors 40mm AA gun in an open-topped turret, the L-62, was more successful. Hungary purchased an example in 1937 which was delivered in 1939. After a few modifications it was placed in

production there as the Nimrod. Finland purchased six of these L-62s, which they called the "Anti", in 1942. Through all of this the Swedish authorities and committees dithered and delayed, looking at a succession of varying combinations of chassis and guns. In January 1942 an order was placed for 50 L-120 vehicles but required changes slowed development. In September 1943 the order for L-120s was

Below: m/31 leading motorcyclists on pre-war maneuvers (KAS)

cancelled and replaced by an order for 17 new vehicles, carrying twin-mount Bofors 40mm on a lengthened L-60 chassis. Optimistically designated the m/43 for service, protracted development problems, never completely solved, delayed their delivery until 1947.

The effectiveness of German assault guns also inspired the Swedes to attempt their own. In February 1943 Scania-Vabis received an order for a prototype assault gun on the m/41 (TNH) chassis. When that was completed they received an order for 18 production vehicles known as the Sav m/43, and subsequently were directed to convert another 18 m/41s on the production line to the same configuration. With deliveries starting in August 1944, these vehicles served





Below: The Czech TNH tank built under licence in Sweden as the Str m/41. Here a Scandia-built vehicle

under the artillery branch, in battalions each of three 6-gun batteries. An attempt was made to develop a similar vehicle for the anti-tank role, the Pvkv m/43 on the m/42 chassis, but this did not come to fruition until 1946.

The Swedish Army's interest in armored cars lapsed during the 1930s. A batch of 30 primitive armored cars based on armored 4x2 truck chassis and known as the Pbil m/31 were purchased in the early 1930s and issued to the cavalry. That branch assigned a three vehicle platoon to each divisional cavalry battalion and the three motorized battalions.

Official lack of interest notwithstanding, Landsverk embarked on the development of a series of medium armored cars based on a variety of truck chassis to meet various export customer needs. The L-180 and L-181 vehicles were invariably based on a 6x4 chassis and mounted a Bofors 37mm gun in a turret. They were thus capable vehicles by the standards of

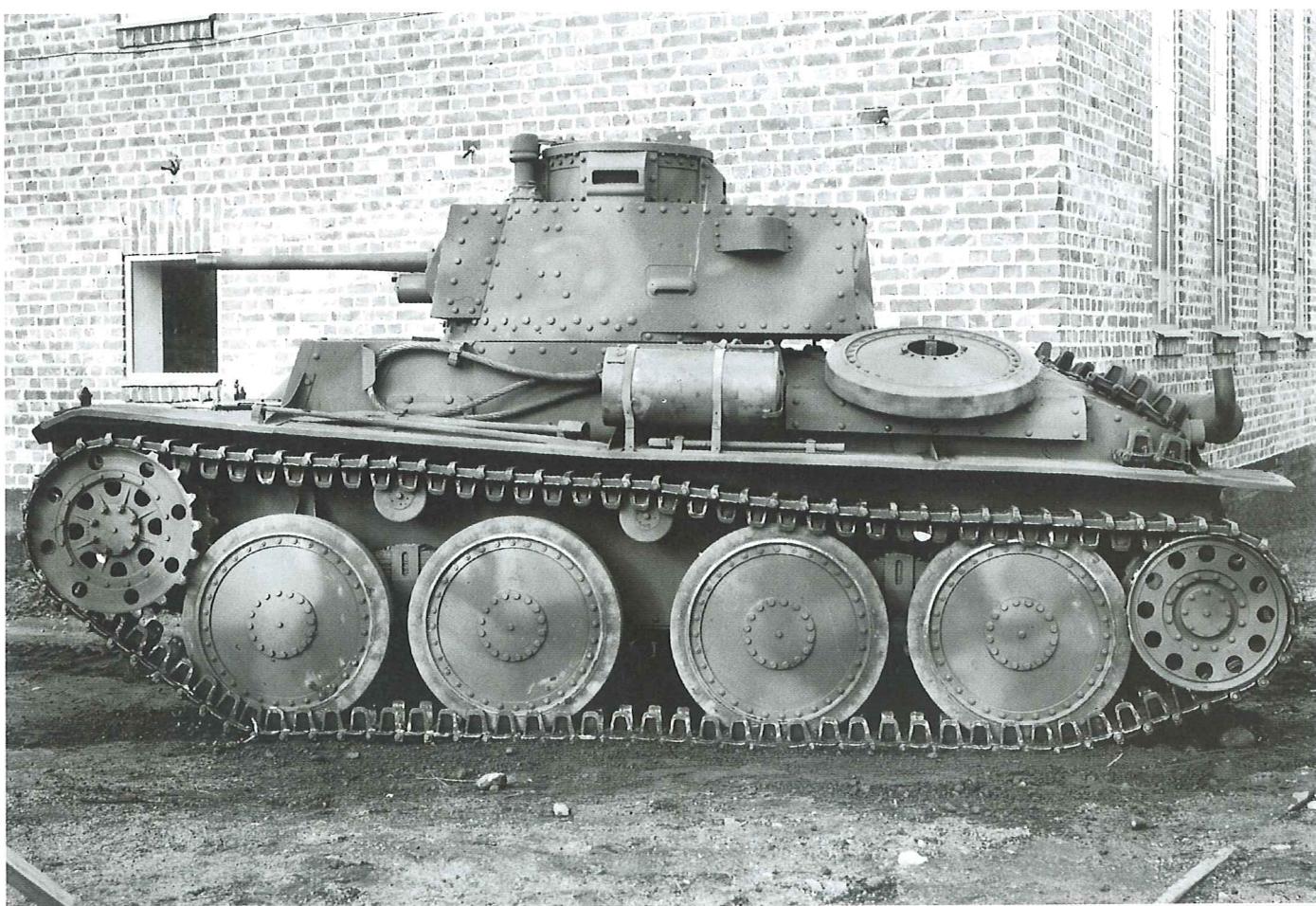
the mid-1930s and sold moderately well. The Lynx was a more advanced vehicle ordered by Denmark and with the German occupation deliveries were embargoed and the Swedish Army took over the 15 vehicles from the 1939 and 1940 contracts as the Pbil m/39. The vehicles apparently impressed them, for the following year they ordered a further 30 vehicles, although Landsverk had to subcontract the work to Volvo for lack of space. The Swedes also confiscated the five Irish L-180s that had not been completed, and these were designated the Pbil m/43. All three distinct models of armored cars served through the war, the old m/31s, the commercial L-180 family and the m/39 Lynx.

Swedish tank development got off to an excellent start with the m/31, but stagnated thereafter, showing only incremental improvements. This may have been due in part to the withdrawal of German assistance to Landsverk. It was almost certainly due to the growth in the size of tanks worldwide. As tanks became heavier, more extensive and heavier

Year	Model	Qty	Customer
1933	L-181	6	Lithuania
1934	L-181	1	Denmark
1935	L-181	12	Netherlands
	L-180	2	Denmark
	L-180	6	Ireland
1936	L-180	1	Estonia
1937	L-180	14	Netherlands
1938	Lynx	3	Denmark
1939	L-180	5	Ireland
	Lynx	9	Denmark
1940	Lynx	6	Denmark
	Lynx	30	Sweden

Landsverk Armored Car Orders

dedicated facilities were needed for production – facilities difficult to justify economically with a limited production run. Thus, the heaviest tank Sweden could produce was only 11 tons until 1942 and 22.5 tons thereafter. By 1944 their "heavy" m/42 tank would have been on the light end of the medium spectrum in most countries.





Strv m/37

When the Swedes purchased the AV-IV tankette from CKD they specified a number of significant changes. The most important was that the nearly useless hull machine gun be moved up to the turret. This concentrated such firepower as it possessed, two 8mm m/36 machine guns, in the turret with 360° traverse. Equally important, if not more so, it opened up space in the hull for the installation of a radio. Fast (60 km/hr) and agile, equipped with a radio, the m/37 could have been an effective reconnaissance vehicle during the late 1930s. Unfortunately, it was the main vehicle of Sweden's sole tank battalion, and in that role was nearly useless. Not only were both the armor and armament weak, but there was only one crewman besides the driver, and he had to function as gunner, tank commander and, if needed, platoon or company commander. As m/40s and m/41s came into service they replaced the little m/37, and by mid-1943 they had been relegated to an independent company on Gotland with six 5-tank platoons.

Strv m/37 (KAS)



	Weight (tonnes)	4.5	Front Armor (mm)	15
	Length (m)	3.40	Side Armor (mm)	10
	Width (m)	1.85	Engine HP	85
	Height (m)	1.95	Road Speed (km/h)	60

Strv m/38-39-40

Developed from the earlier L-10, the Landsverk L-60 was purchased in several batches, each differing slightly from the others. The initial 16 vehicles (m/38) were fast and well-armed, but had thin armor and a two-man turret. The second batch of 20 vehicles (m/39) were similar, but mounted two coaxial machine guns rather than the one on the m/38 and moved them from the left of the main gun to the right. The third batch of 100 vehicles was originally designated the m/40, then the m/40L. The main differences from the earlier batches were the use of an automatic transmission and attachment points for additional armor on the front that would raise the thickness to 50mm. By using a Swedish Atlas-Diesel Lysholm-Smith transmission originally developed for buses, the

Strv m/40L (KAS)





m/40 became the first production tank in the world to use an automatic transmission. The fourth batch of 84 was known as the m/40K, to signify that it was built by Karlstad Mekaniska Verkstad rather than Landsverk and incorporated the thicker armor as a production feature, and to compensate for the additional weight used a 160 hp engine and more robust suspension elements. The Bofors 37mm gun used as the main armament in all the series was a

fine weapon in the late 1930s but by 1942, when the m/40 began deliveries, it was obsolescent and by 1944 (when the m/40K was delivered) it was all but useless. The small hull meant that a more efficient three-man turret could not be adopted, nor could a larger weapon

be fitted. Weaknesses notwithstanding, the L-60 series formed the backbone of the Swedish tank force as its only cannon-armed tank until 1944. Although redesignated as a light tank in 1943, in fact it continued as the most numerous tank until late 1944.



Weight (tonnes)	9.1	Front Armor (mm)	15
Length (m)	4.90	Side Armor (mm)	10
Width (m)	2.08	Engine HP	142
Height (m)	2.05	Road Speed (km/h)	45

Strv m/42

The manifest shortcomings of the m/38-39-40 and m/41 families, particularly their weak armament, led to the development of a heavier tank based on the Landsverk "Lago" tank originally developed for export. The new tank shared many of the suspension components with the earlier L-60 series, but required a more powerful engine to match the increased weight. In fact, the original configuration of two engines was changed to a single larger engine and an early electric transmission was replaced by a more conventional automatic unit during the production runs at the two factories. Suffixes denoted whether the tank had one 410 HP Volvo engine (E) or two 160 HP Scania-Vabis engines (T), and whether it had a hydraulic (H) or electromagnetic (M) transmission. Production totalled 100 m/42TM, 70 TH and 10 EH from Landsverk, and 55 TH and 47 EH from Volvo. Armament was a medium-velocity Bofors 75mm gun that was a great improvement on the 37mm weapons



used earlier, although by the time deliveries started in 1944 it was probably marginal on the contemporary battlefield in terms of tank killing.

The m/42 retained the twin coaxial machine gun arrangement unique to Landsverk and placed a third weapon in the hull front.



Weight (tonnes)	22.5	Front Armor (mm)	55
Length (m)	6.22	Side Armor (mm)	n/a
Width (m)	2.34	Engine HP	320
Height (m)	2.59	Road Speed (km/h)	42



Sav m/43

The success of German and Soviet assault guns spurred the Swedes to develop their own version, using the only suitable chassis available at the time, that of the TNH (m/41). Scania-Vabis developed the vehicle, replacing the superstructure with a fixed casemate mounting the 105mm L/27 m/44 howitzer with pepper-pot muzzle brake. The TNH was a rather small chassis, so the four-man crew must have been rather cramped, when combined with the 105mm gun and 43 rounds of ammunition. The armor was actually somewhat thin for an assault gun and that, plus the lack of a machine gun for close-in defense, points towards their use as self-propelled direct-fire support weapons, rather than actual assault guns. Given those limitations, however, it was apparently a fairly effective design and it remained in service until 1970.

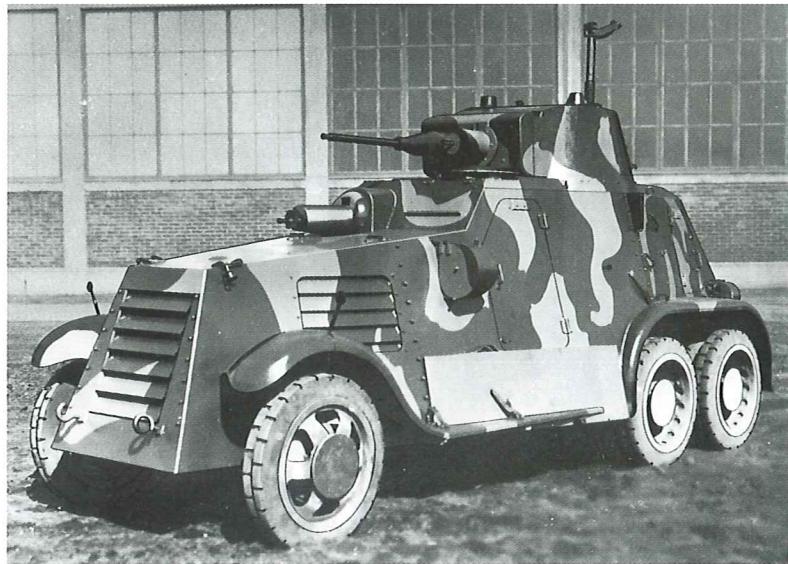
Sav m/43 (KAS)



	Weight (tonnes)	12.4	Front Armor (mm)	30
	Length (m)	4.60	Side Armor (mm)	15
	Width (m)	2.14	Engine HP	140
	Height (m)	2.29	Road Speed (km/h)	43

L-180/181 Armored Cars

Landsverk was one of a handful of firms that took advantage of the proliferation of 6x4 heavy truck chassis designs in the 1930s to create relatively inexpensive armored cars. The first model built, the L-181, used a Daimler-Benz chassis. The vehicles sold to Lithuania were armed with a 20mm Oerlikon gun in the turret (with a coaxial MG), while those for the Netherlands used a 37mm Bofors gun. The slightly later L-180 used a Büssing-NAG chassis. The single Estonian vehicle used the Oerlikon gun, while all the others used the Bofors gun. All vehicles mounted a second MG in the hull to the side of the driver. The Swedish government confiscated five undelivered Irish L-180s, which were turned over to the army with the designation pbil m/39. In October 1941 the decision was made to replace the original turrets with units identical to those used in the Pbil m/40 Lynx. By the standards of the mid 1930s the L-180 family was an adequate design, with moderate cross-country mobility and a good armament. By 1941, however, all-wheel-drive designs conclusively showed the limitations of commercial truck chassis and the thin armor would have rendered them dangerous vehicles to inhabit on the battlefield.



An L-180 with Oerlikon 20mm gun

	Weight (tonnes)	7.4	Front Armor (mm)	9
	Length (m)	5.87	Side Armor (mm)	9
	Width (m)	2.24	Engine HP	180
	Height (m)	2.48	Road Speed (km/h)	65



Lynx Armored Car

Development of a modern 4x4 armored car began in 1937 and a demonstrator was running by 1938. The vehicle, known as the "Lynx" featured unibody construction with the engine in the middle on the left side. At both front and back were positions for a driver and a hull machine gunner. A further two men fit into the turret, to give a crew of six. The turret mounted a 20mm Madsen automatic cannon and a coaxial machine gun. Three were delivered to Denmark in April 1938, but a further order for 15 had not been delivered by the time of the German invasion and these were confiscated for Swedish use as the Pbil m/40. Although the ground clearance appears low for their wheelbase, they seem to have been highly regarded, and a further 30 were ordered for the Swedish Army.



Pbil m/40 "Lynx" (KAS)

	Weight (tonnes)	7.8	Front Armor (mm)	18
Length (m)	5.10	Side Armor (mm)	n/a	
Width (m)	2.30	Engine HP	140	
Height (m)	2.20	Road Speed (km/h)	73	

SKP m/42

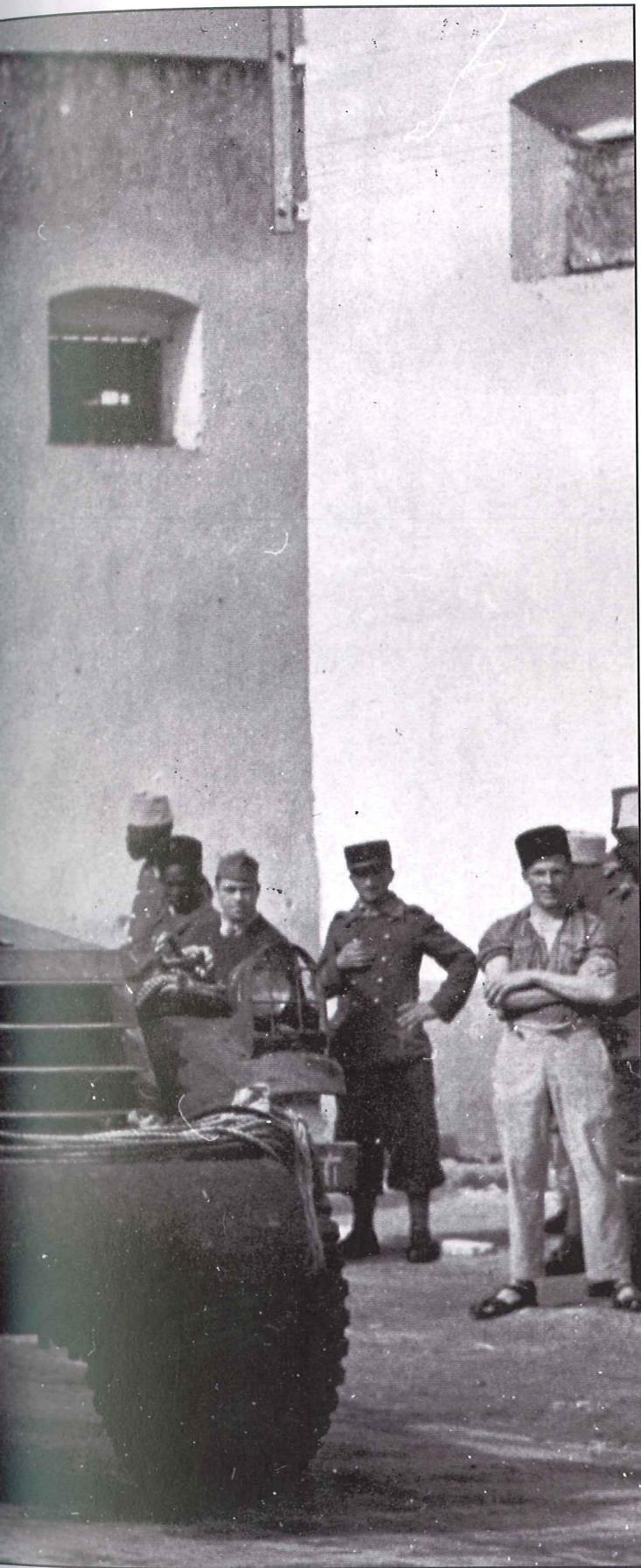
To provide the infantry of the armored brigades with some protection the firm of Bröderna Hedlund designed an armored hull to fit on a 3-ton 4x4 truck chassis. A total of 262 vehicles were delivered starting in 1943. Each vehicle carried its crew of a driver and a commander in an armored front cabin and 16 passengers in a low-sided, open-topped compartment at the rear. Unarmed until after the war and ungainly, they were at least reliable and easy to maintain. As a result, these vehicles remained in service until the 1980s.



SKP m/42 personnel carrier (KAS)

	Weight (tonnes)	6.7	Front Armor (mm)	15
Length (m)	6.80	Side Armor (mm)	15	
Width (m)	2.30	Engine HP	105	
Height (m)	2.28	Road Speed (km/h)	50	





United States

Pre-War Tanks

There were two centers of tank design during the prewar period. The Army's in-house facility was at Rock Island Arsenal, which not only performed engineering development, but also produced small quantities of tanks. The other source of tank design was the commercial shop of eccentric J. Walter Christie, a brilliant automotive engineer but less successful in converting his designs to useful combat vehicles. Of the two, Rock Island Arsenal followed the more conservative approach, resulting in a series of evolutionary designs that gradually incorporated turrets, new track and suspension designs and more powerful engines. Christie, however, obsessively pursued the increase of speed, largely through the use of his patented new suspension that used large road wheels with long vertical travel via trailing arms and large springs. Another characteristic of many of his designs was a "convertible" feature that allowed the tracks to be removed and the tank to run directly on its road wheels, with power delivered to the rearmost set of wheels.

Unfortunately, Christie possessed both an apparently limitless facility for antagonizing the US War Department and a seeming inability to apply his new suspension to a practical combat vehicle. The US bought small numbers of his convertibles as the T3 medium tanks (for the infantry) and the T1 combat car (for the cavalry), and built a few modified versions at Rock Island as the T4 medium tank, but this was to prove a dead end in the US. Christie did export some prototypes (some covertly) and the Soviets and British were able to incorporate his suspension into very effective tanks, albeit without the convertible feature.

Meanwhile, the army continued with its own development of small tanks. Unnecessary complexity was added by a provision of the 1920 Defense Act that restricted tanks to the infantry branch, so the cavalry had to term their equivalents combat cars. As a result the new tank project that was initiated in June 1933 called for the development of two similar, but not identical vehicles, a light tank for the infantry and a combat car for the cavalry, both to be developed by Rock Island Arsenal.

The cavalry version was first off the mark, a 7-ton vehicle with four road wheels on two bogeys each side and armed with a .50cal and a .30cal machine gun side by side in a turret and a second .30cal in the hull front. The pilot model, known as the T-5, was demonstrated along with its infantry branch counterpart, the T-2, in 1934 and production began as the



M1 combat car in 1935. Tests were undertaken with a modified vehicle in which the bogeys were spread further apart to increase ground contact and this version was approved for production as the M1A1 combat car. Finally, the rear idler was enlarged and lowered to ride on the ground and this went into production in 1940 as the M2 Combat Car.

The infantry version was delayed slightly by indecision of what suspension to use but they quickly settled on the same arrangement as the M1 Combat Car. The original M2A1 Light Tank was similar to the combat car, but carried the two MGs in the turret in a coaxial mount and added a cupola to the roof of the turret. This was quickly superseded, however, by the M2A2 light tank, with two turrets, one with a .50cal armament on the left, and the other, slightly smaller, with a .30cal weapon, on the

right. The next modification came with the M2A3 light tank, which adopted the spaced-apart bogeys of the M2 Combat Car and increased the maximum armor thickness from 16mm to 22mm, increasing vehicle weight to 10.5 tons. The vehicle retained, however, the anachronistic twin-turret arrangement.

The final incarnation of the M2 light tank

was to prove an important one. In 1938 the Chief of Infantry requested a light tank that was armed with a 37mm gun and coaxial light MG and in early 1939 the final M2A3 was taken off the production line and extensively modified with a single turret with the requested armament, while maximum armor was increased to 25mm. After tests in mid-year

	1932	1933	1934	1935	1936	1937	1938	1939
Combat Car, M1	-	-	-	41	19	30	-	-
Combat Car, M1A1	-	-	-	-	-	-	24	-
Light Tank, M2A1	-	-	-	10	-	-	-	-
Light Tank, M2A2	-	-	-	9	125	104	-	-
Light Tank, M2A3	-	-	-	-	-	-	73	-
Medium Tank (convertible), T3	-	3	-	-	-	-	-	-
Medium Tank (convertible), T3E2	-	-	5	-	-	-	-	-
Medium Tank (convertible), T4	-	-	-	-	10	16	-	-
Medium Tank, T5	-	-	-	-	-	-	2	-
Medium Tank, M2	-	-	-	-	-	-	-	18

US Pre-War Tank Production by Fiscal Year

Above: An M2A2 light tank on maneuvers at Plattsburgh NY in August 1939



some changes were mandated, including shortening the main gun length by 13cm to prevent damage to the weapon in heavily wooded areas, and the resulting vehicle was standardized as the M2A4 light tank in early 1940, with production beginning in May.

In medium tanks the infantry branch remained seduced by the promise of Christie's convertible tanks, producing small quantities of T3s in the early 1930s. The T4 retained the convertible feature with Christie suspension, but was built at Rock Island Arsenal in 1936-37. The turret was similar to that of the M1 Combat Car in earlier versions, replaced by a fixed superstructure in later versions. The tank was not popular with War Department planners, since it cost much more than the M2-series light tanks without any increase in firepower. It was finally, grudgingly, standardized as the M1 medium tank in March 1939, at which time 19 remained in service. In March 1940 they were declared obsolete.

Much more significant was the development of the T5 medium tank. The convertible feature was finally discarded and, under a program launched in May 1936, two prototype tanks were developed. Both featured six roadwheels on three bogeys each side, with a high box-like superstructure. In the T5 Phase I a .30cal MG was placed at each corner of the superstructure in rotating sponsons. This was surmounted by a turret with a 37mm M3 gun and coaxial .30cal MG. In the T5 Phase II the right front sponson was deleted and a 75mm pack howitzer placed there facing forward. In this vehicle the turret was much smaller, accommodating a .30cal machine gun facing forward and optical range-finder arms protruding to the sides.

After some modifications the T5 Phase I was standardized as the medium tank M2, with production of 18 to begin in mid-1939. A further 54 tanks were authorized for 1940, but were cancelled in light of the rapid pace of tank development in the US and overseas.

Light Tanks

Although few had been built, the development of the M2 series of light tanks had left the United States in the enviable position of having a fast, reliable light tank that would serve as the basis for all their light tanks into 1944. A contract was placed with American Car &

Foundry in 1939 for 329 tanks, and a further 36 were later added for the British. These contracts were completed in March 1941. None appears to have been used in combat by the US or British Armies, although the USMC did send a few to Guadalcanal where they participated in the fighting there.

Troop trials revealed the need for some improvements in the M2A4. As a result, the idler was dropped to the ground to reduce ground pressure, and the recoil mechanism on the main gun was shortened so it no longer protruded in front of the shield. The resultant vehicle was designated the M3 light tank in July 1940 and ordered into large-scale production at American Car & Foundry on completion of their M2A4 contract. Detail changes were continually made in the M3 during its production run. After about 300 had been built the original turret, built of bolted face-hardened armor sheets was replaced by a welded turret, and that in turn was later replaced by one of rolled and formed homogenous armor.

Faced with an engine shortage the Army approved the replacement of the Continental W-670 gasoline engine with the Guiberson T-1020 diesel on a portion of the tanks. The resultant vehicles were produced at the same factory in parallel with the original versions and were not given an official designation except for the references to M3 (gas) and M3 (diesel) used when needed.

Large numbers of M3s were transferred to the British (who christened them "Stuarts") as lend-lease and their experiences in the desert were relayed back to the US. A turret basket was required so that the gunner and commander (who doubled as the loader) would rotate with the turret and that, in turn, required power traverse. With power turret traverse in place the prior feature of permitting 10° of traverse on the gun could be dispensed with and the gun fixed in azimuth. Gyro stabilization was also fitted. The cupola on top of the turret was found unnecessary and was dispensed with, while the sponson-mounted .30cal machine guns were also eliminated as unproductive. The incorporation of these changes yielded the M3A1 (gas) and M3A1 (diesel) light tanks.

Unfortunately, in the rush to get new tanks into the field as quickly as possible the new components were added to the tanks as soon as

they arrived at the factory, yielding a bewildering array of interim versions with varying combinations of features, including some combinations that rendered the tanks absolutely useless for combat, such as manual traverse and fixed gun. The British called these tanks "hybrid Stuarts" but the US did not officially recognize them, further compounding the problem.

The confluence of two trends created the next model of light tank. The first was the shortage of air-cooled radial engines, which were also in demand for the air force. The use of diesels was an alternative, but the Army was reluctant to establish two supply lines for different fuels. Indeed, in March 1942 the Adjutant General made it official by directing that as far as possible all diesel-engined tanks were to be retained in the US as training vehicles. The solution was to install two Cadillac engines with Hydramatic automatic transmissions and an automatic auxiliary transmission. Although some scepticism was expressed at the time regarding the difficulty of keeping twin power packs synchronized in the field, the arrangement worked well in practice, providing both high power and acceptable reliability. This did, however, require raising the rear engine deck to accommodate the engines and cooling systems. The second was the movement towards a redesigned homogenous steel armor upper hull. The front face of the tank was moved forward, yielding more room for the driver and assistant driver and dual controls were fitted. The resultant new tank was designated the M5 light tank and production began at Cadillac in April 1942, with other firms being brought in shortly thereafter.

A new turret was also subsequently designed, adding a bustle in the rear to accommodate a radio, resulting in the M5A1. At the same time, the improved efficiency of the M5 hull had become apparent and some M3-series tanks were built with the forward hull of the M5 and the turret of the M5A1. This was designated the M3A3 and was, essentially, an M5A1 but with the engine (and lower engine deck) of the M3A1 (gas).

The M3 and M5 series light tanks had proven themselves fast and reliable. Even early experiences in Operation Torch, however, showed them to be undergunned. It was made



JANE'S TANKS OF WORLD WAR II

painfully clear in North Africa that earlier thoughts of using light tanks as combat assets were misplaced, and they were quickly relegated to the reconnaissance role until a more effective model could be developed. In late 1942 efforts were begun to attempt mounting a 75mm gun on the M5 chassis, an attempt that failed. Attention then turned to building a new light tank (albeit with the power pack of the M5) and a new gun to yield the T24 light tank.

The new tank was a complete break with prior US design practices. It used a torsion-bar suspension that gave good cross-country performance. The armor, although thin, was well sloped to give acceptable protection for a light tank. The gun chosen was the 75mm T13E1 that had been designed for use in the B-25H bomber. The T13 had the same ballistic performance as the 75mm M3 tank gun, but had a thinner barrel. This caused the barrel to heat up more quickly and reduced service life, but cut the weight in half. A new concentric short recoil system permitted mounting of the gun in a tank turret.

Production of the T24 began at Cadillac in April 1944 (replacing M5A1s previously contracted for) and the vehicle was standardized as the M24 in July. The M24 proved the best light tank of the war; fast, agile, reliable and well armed.

One model of light tank that fell outside the main stream of US light tank development was the M22 airborne light tank. A general statement of required characteristics was promulgated in May 1941 and Marmon-Herrington and Pontiac both responded with proposals. The Marmon-Herrington offer was substantially cheaper and was accepted. Production of the tank, now known as the T9E1, began in April 1943 and continued through February 1944. It was not standardized until September 1944 as "limited standard" as the M22 light tank. In retrospect the M22 cannot be considered a very useful vehicle. Its 37mm gun had long since seen its anti-tank capability eclipsed, yet it did throw a useful HE round. There is no record of attempts to mount a 75mm pack howitzer in the turret, in the manner of the M8 motor howitzer carriage, but

in November 1943 a project was begun to fit a breech-loaded 81mm mortar in lieu of the main gun. This was accorded a low priority, however, and work proceeded slowly until the end of the war when the proposed vehicle, designated T9E2, was cancelled. The M22 was never used in combat by the US, but some were supplied to the British who used them in the Rhine crossings.

Medium Tanks

The crushing defeat of France by the panzerwaffe in May 1940 had two profound consequences for the US armored force, one beneficial, the other pernicious. In the short term, it hammered home the obsolescence of the M2A1 tank with its high silhouette, thin armor and 37mm main gun. A pressing need was immediately recognized for a tank with a 75mm gun, in large numbers, quickly.

The technical side of the problem benefited from the T5 Phase III medium tank, which had mounted a pack howitzer in the hull. It was obvious that a turreted weapon was desirable,

but no suitable turret existed and so a two-prong approach was launched. On the one hand the T5 Phase III would be quickly further developed to yield a tank suitable for interim use, while at the same time work would commence on a turret to yield the desired mid-term tank solution. The former was to lead to the M3 Lee/Grant and the latter to the M4 Sherman.

The quantity problem was solved with equal dispatch. It was clear that Rock Island Arsenal lacked the expertise to manage and implement the huge production levels needed. On 7 June 1940 the War Department asked Chrysler, which had considerable experience in mass production methods, if they would produce tanks for the Army. On 15 August they awarded the firm a contract for 1,000 M2A1 mediums, to include the construction of a brand-new purpose-built tank factory in Detroit with a capacity of 100 tanks per month. Only 13 days later the M2A1 contract was cancelled and replaced by one that specified the new M3 medium tank, so far not even designed. In the meantime, Rock Island Arsenal was given a contract for 126 M2A1s for



Right: An M4 A3E8 76mm Sherman of the 10th Armored Division enters Rosswalden in Germany, 20 April 1945



	1940	1941	1942	1943	1944	1945
Light Tanks						
Combat Car, M2	34	-	-	-	-	-
Light, M2A4	325	40	10	-	-	-
Light, M-H 7-ton	-	-	240	-	-	-
Light, M3 (gas)	-	2,072	2,454	-	-	-
Light, M3 (diesel)	-	479	802	4	-	-
Light, M3A1 (gas)	-	-	4,370	40	-	-
Light, M3A1 (diesel)	-	-	211	-	-	-
Light, M3A3 (gas)	-	-	2	3,425	-	-
Light, M5	-	-	2,074	-	-	-
Light, M5A1	-	-	784	4,063	1,963	-
Light, M22	-	-	-	680	150	-
Light, M24	-	-	-	-	1,930	2,801
Medium Tanks						
Medium, M2A1	6	88	-	-	-	-
Medium, M3	-	1,033	2,915	-	-	-
Medium, M3 British	-	309	667	-	-	-
Medium, M3A1	-	-	300	-	-	-
Medium, M3A2	-	-	12	-	-	-
Medium, M3A3	-	-	322	-	-	-
Medium, M3A4	-	-	109	-	-	-
Medium, M3A5	-	-	284	-	-	-
Medium, M3A5 British	-	-	307	-	-	-
Medium, M4 (75mm)	-	-	475	6,082	191	-
Medium, M4A1 (75mm)	-	-	1,785	4,496	-	-
Medium, M4A2 (75mm)	-	-	2,811	4,408	834	-
Medium, M4A3 (75mm)	-	-	514	1,176	2,420	651
Medium, M4A4 (75mm)	-	-	2,432	5,067	-	-
Medium, M4A6 (75mm)	-	-	-	16	59	-
Medium, M4A1 (76mm)	-	-	-	-	2,171	1,255
Medium, M4A2 (76mm)	-	-	-	-	1,594	1,321
Medium, M4A3 (76mm)	-	-	-	-	3,370	1,172
Medium, M4 (105mm How)	-	-	-	-	1,241	400
Medium, M4A3 (105mm How)	-	-	-	-	1,045	1,994
Medium, T23	-	-	-	1	249	-
Medium, T25E1	-	-	-	-	40	-
Heavy Tanks						
Heavy, M6	-	-	1	7	-	-
Heavy, M6A1	-	-	-	12	-	-
Heavy, M6A2	-	-	-	16	4	-
Heavy, T26E1	-	-	-	-	10	-
Heavy, M26	-	-	-	-	40	2,162
Heavy, T26E2	-	-	-	-	-	185
Heavy, T26E5	-	-	-	-	-	27

note: figures include Lend-Lease vehicles, but not commercial sales

US Wartime Tank Production

use as training vehicles.

The more baleful effect was the decision reached by Army Ground Forces, responsible for doctrine and tactics, that the answer to massed tank attacks was the creation of a separate anti-tank force. Tanks were to be used

for the exploitation role, while combating enemy tanks was to be left to the new Tank Destroyer force. Under this theory not only were tanks not required to fight enemy tanks, but they were actively discouraged from doing so. From the creation of the tank destroyer arm

in November 1941 until mid-1944 AGF actively opposed (usually successfully) the production of tanks with improved anti-tank capabilities.

The chassis of the M2 and T5 tanks were retained for the new M3 medium but the corner machine guns in their rotors were discarded. The primary weapon was to be a 75mm gun M2, which fired the same ammunition as the M1897 field gun, although at a slightly lower velocity due to the shorter barrel. Two fixed machine guns were set into the hull to be fired by the driver. The superstructure was surmounted by a turret with a 37mm gun and coaxial machine gun, and that in turn, was topped by a cupola with yet another machine gun. The whole assembly required six or seven crewmen.

A series of continual improvements were seen in the M3, although none altered its archaic configuration. The slightly longer M3 gun replaced the M2 to yield somewhat better performance, the side doors were eliminated, and the driver's fixed machine guns dispensed with. In June 1941 the Ordnance Committee authorized the construction of upper hulls by casting instead of rivetting sections together, and this resulted in the M3A1. The use of an all-welded hull resulted in the M3A2, but only a few were built before production shifted to the M3A3, which used a pair of General Motors 6-71 diesel truck engines. A version that reverted to the riveted hull was designated the M3A5. Another solution to the engine shortage was to combine five 6-cylinder automobile engines in a star pattern. This bulky power plant, dubbed the A57 multibank engine, would fit into the M3 only if the engine compartment were made 28cm longer, necessitating a wider spacing of the bogeys. This configuration was designated the M3A4.

As was to become common with the Sherman, the varying designations did not necessarily indicate any chronological order of production, but rather varying solutions to manufacturing needs and component shortages. Thus, in June 1942 the Detroit Tank Arsenal was building M3s and M3A4s, Baldwin Locomotive M3A3s and M3A5s, Pressed Steel and Pullman Standard M3s, and American Locomotive M3A1s.

The armored force submitted its



JANE'S TANKS OF WORLD WAR II

requirements for an M3 replacement in August 1940, even before the M3 had entered production. Two overriding demands drove the design process. The first was to move the 75mm from the hull into a fully-rotating turret. The second was to use as much of the M3's automotive essence as possible in order to speed transition from one tank to the other on the manufacturing lines. A prototype, using the chassis, suspension and power plant of the M3 medium, was delivered in September 1941 as the T6 medium tank. In December 1941 the Sherman was standardized in two variants, the M4 with a welded hull, and the M4A1 when it used a cast upper hull.

Production of the Sherman was managed by a joint US-British tank board. In fact, the first Sherman (an M4A1) came off the British-funded Lima Locomotive Works in February 1942. The recurring concerns about the availability of the Wright radial engine led to the adoption of the twin GM 6-71 arrangement as on the M3A3, this being designated the M4A2. This model was the second to see production, at Fisher Tank in April 1942. Although sensitive to dirt, the engines were generally reliable and delivered plenty of torque at low revolutions, yielding good cross-country performance. Nevertheless, the War Department policy against deploying diesel-engine tanks to combat theaters meant that most M4A2s were used for training or distributed as international aid to the British and Soviets. The next solution to the engine problem was to adapt the Ford GAA 8-cylinder gasoline engine for tank use, an easy task since it was quite compact. In fact, it lowered the driveshaft through the center of the tank noticeably and thus made the tank somewhat easier to crew and maintain. This version was standardized as the M4A3 in January 1942 and the first production model came off the Ford production line in August, just a month after the first basic-model M4. The final model of Sherman, the M4A4, used the Chrysler multibank engine first installed in the M3A4. As with the earlier M3A4 the hull had to be lengthened to accommodate the large, complex engine, although experiences with the previous model simplified the transition.

All the models went through a series of design changes that were generally not reflected by change in nomenclature. One of the most

noticeable was to make the front upper hull more nearly vertical, which eliminated the need for protruding hoods for the driver and assistant driver. Another change was the move from the original vertical-volute spring suspension to a horizontal-volute spring suspension (HVSS). The HVSS improved cross-country mobility noticeably and it was approved for all models of Shermans in March 1944. Tanks built with this feature carried the additional suffix E8 (universally referred to as "easy-8"), i.e., the M4A1E8, M4A2E8 and the most numerous M4A3E8.

Certainly, the most contentious issue of American medium tank design during the war was that of armament. The Ordnance Department built two 76mm guns with higher muzzle velocity than the 75mm M3 and fitted them to Shermans for test in August 1942. They considered the tests successful and recommended the manufacture of 1,000 such tanks. After service tests in early 1943, however, the Armored Force rejected the design as having an inefficient and cramped turret interior.

By this time the Ordnance Department was hard at work on their successor to the Sherman, the T-20 series with hybrid electric drive and a 76mm gun. The turret of the T-23 variant was similar to that of the M4 and in July 1943 an M4E6 with the T-23 turret was tested at Aberdeen and performed well.

On 1 September 1943 the Armored Force requested production of the 76mm-armed Sherman in such numbers that ultimately one-third of the mediums would be so armed. Most Shermans, therefore, were to continue with the 75mm. The reasons had much to do with the role of tanks as envisioned by the center – they were not to engage enemy tanks, that was to be left to the tank destroyers. The 76mm did, indeed, have better armor penetration performance than the 75mm M3, but set against that its HE round actually held only half the explosive fill of the 75mm HE, the larger ammunition meant that fewer could be carried in the tank, and the muzzle blast frequently obscured the gunner's view with smoke and dust. As a way around this, both the Ordnance Department and the Armored Force requested tanks with 90mm guns, but Army Ground Forces rejected that call, arguing that they did not need tank-killing capability in their tanks.

Experience with the M36 tank destroyer showed that such a weapon could be mounted on a Sherman chassis, but no such tank was to be built.

After the Normandy invasion it became clear that the Sherman was no match for either a Panther or a Tiger, even with the 76mm, and bitter recriminations began to fly. The reasons for the fiasco were many. First, the commanders in the field, not having faced the most modern German tanks in any numbers, never expressed any concern about the 75mm gun of the Sherman up to that point. Indeed, most had pronounced themselves quite pleased with the Sherman as it was. Second, the Ordnance Department's support for a bigger gun on the Sherman waned after 1942, probably for fear that it would weaken the push for their all-new tanks such as the T-20, T-23 and T-26. Third, the engineers at the Ordnance Department produced over-optimistic figures for armor penetration by the 75mm M3 and the 76mm M1 as a result of failing to properly factor in the effect of sloped armor, thus leading to a false sense of security. Finally, the adamant stance of Army Ground Forces under General McNair that US tanks were not to fight enemy tanks led to an out-of-hand rejection of almost any weapon that promised to give Shermans a useful anti-tank capability. Whatever the main reason, American tankers were to pay a heavy price in late 1944 and early 1945.

Appeals to increase the high-explosive firepower of the Sherman, on the other hand, met no opposition whatsoever. Initial tests on an M4A4 with a 105mm howitzer were conducted in December 1942 and two more, incorporating modifications as a result of the first test, were proof fired in August 1943. The first of an initial lot of 500 M4A3 with the howitzer was produced at the Detroit Tank Plant in May 1944. Those were followed by a second batch of 2,539 with HVSS. The tanks were produced without power traverse, this being considered unnecessary, but a few of the late-production vehicles were so fitted, too late to see service in Europe.

One further variant of the Sherman to enter production was the M4A3E2 assault tank. This involved welding an additional 38mm of armor over the hull front and on the sponson sides, and the use of a new turret with walls 150mm



thick. It retained the standard 75mm M3 gun, since it was intended for the infantry support role, but used heavier differential and final drive components to compensate for the weight of 42 tons. Fisher built 254 M4A3E2 in May-July 1944 and they proved popular in combat. Once in Europe the 75mm gun was replaced by the 76mm in many tanks as a field conversion.

Although the firepower was needed, the US employed only a handful of Firefly (17pdr) Shermans. Fifth Army in Italy received about a dozen British Fireflies from their counterparts and used them in the final weeks of the campaign. For North-West Europe, however, nothing was done until March 1945, when a contract was placed with Woolwich Arsenal in the UK for the installation of 17pdr guns into 160 (later reduced to 80) US Shermans. The tanks were delivered to the continent starting in

April, but none were issued to units before the war ended.

Heavy Tanks

During 1919-1920 Rock Island Arsenal had built 100 Mark VIII heavy tanks, based on the British design. In 1932 they were removed from troop service and placed in storage, and in May 1936 the Army requirement for a heavy tank was officially rescinded. The bulk of the Mark VIIIs were eventually sold to Canada in 1940 for training vehicles and then scrap.

In May 1940 the Ordnance Committee recommended the development of a heavy tank and a formal project for the T1 heavy tank was approved in July. A month later a contract was signed with Baldwin Locomotive for the design and construction of a prototype heavy tank, to be followed by 50 production vehicles.

Development followed a variety of diverging

Below: The first T26 E3 platoon enters Germany on the road between thum and Ginnick on 1st March 1945

paths as the engineers struggled with problems with hull construction and motive power. Although testing had not been completed, two models were standardized as the M6 and M6A1 in February 1942. In the meantime, opinion in the Armored Force had been shifting against the heavy tank and in December 1942 they recommended cancelling the program. Forty vehicles were finally built, consisting of 8 M6s, 12 M6A1s and 20 T1E1 models, the last featuring a hybrid electric drive. All weighed about 64 tons, had a maximum armor thickness of 100mm, and were armed with a 3" M7 gun. Subsequent tests showed all the models to be unreliable, the T1E1 especially so, and none ever left the US.





JANE'S TANKS OF WORLD WAR II

The new American heavy tank was to spring from a failed series of medium tanks designed to replace the Sherman. A range of parallel efforts were involved, the T20 with hydramatic transmission, the T22 with manual transmission, the T23 with electric transmission, all with 76mm guns in most of their incarnations, the T25 with 90mm gun, and the T26, an up-armored T25.

Modifications in early 1944 yielded the T26E1 medium tank, redesignated a heavy tank in June 1944. In that same month the ETO informed the War Department that it wanted no more 75mm or 76mm-armed tanks for delivery in 1945, that only 90mm gun and 105mm howitzer armed vehicles were needed. Nevertheless, Army Ground Forces fought a bitter delaying action to prevent a 90mm tank from entering service.

The AGF efforts were, for the most part, successful. Production of the first 20 T26E3s (the result of further improvements) did not begin until November 1944 and these were hurriedly shipped to Europe in January 1945 following the Ardennes scare. Full production was authorized in January 1945 and in March the T26E3 was standardized as the M26 heavy tank. Although still flawed, it was the only American tank that could take on a Panther or Tiger on relatively even terms, and proved popular on that basis during its brief combat career.

Tank Destroyers

Starting in 1941 the US Army assigned the mission of destroying enemy tanks not to the tank force, but to a specialized branch known as tank destroyers using a mixture of towed and self-propelled anti-tank guns. Doctrine called for the TD battalions to be held in reserve until a breakthrough occurred, implying a great deal of mobility in order to reach the threatened area in time. It was also assumed that they would fight from defensive positions, reducing the need for armor protection. The SP tank destroyers were thus usually characterized by high mobility, strong firepower and thin armor.

At the time the tank destroyer force was formed there were no SP tank destroyers, so improvisation was clearly called for. The results were the M6, a 37mm gun on the back of the truck, and the M3 motor gun carriage, the

75mm M1897 gun mounted on the M3 half-track. Both were sent to North Africa for Operation Torch, where the former proved useless and the latter acceptable, but only as an interim weapon.

The Ordnance Department's solution was to use the chassis and power plant of the M4A2 Sherman, but with a more thinly-armored superstructure and a welded open-topped turret mounting a 3" M7 gun. It was standardized as the M10 motor gun carriage in June 1942. The tank destroyer center bitterly fought standardization of this vehicle, feeling that it was not significantly faster or lighter than a standard Sherman and therefore unsuited to their assigned mission. Nevertheless, a contract was let to Fisher for M10s, which began production in September 1942, and, to speed deliveries, a parallel contract was awarded to Ford to build vehicles using the chassis of the M4A3 as the M10A1.

For tank destroyer doctrine to be successful a light, fast, hard-hitting vehicle was needed, and the M10 was clearly not the answer. Development of a tank destroyer based on the light tank chassis had begun in 1941 but had gone nowhere. Instead, development turned to an entirely new chassis using a Christie suspension and a 75mm gun as the T67. Tests in November 1942 showed promise and the vehicle was modified to accept the 76mm gun and the suspension changed to a torsion-bar system as the T70. In response to pressure from the Tank Destroyer force the T70 was rushed into production in July 1943, although it was not standardized as the M18 motor gun carriage until March 1944. The accelerated development inevitably led to large numbers of faults, none of which required major

modification of the vehicle but the cumulative effect of which made large numbers unsuitable for combat. Improvements were cut into production as they were developed, leading to logistics chaos. By February 1944 some 1,200 T70s had been produced, of which 1,097 required modification to conform to standards. Of those, the first 658 built had to be returned to the factory for rebuild.

Once the problems were sorted out the Tank Destroyer Command got exactly what it had asked for – a thinly armored, very fast tank destroyer. At 80 km/hr it was the fastest tracked vehicle in the US Army. It was even evaluated for possible use as a light tank, but was rejected because the armor was too thin, the turret was open-topped, and there was no machine gun armament other than the .50cal AA weapon. The high speed certainly conferred tactical advantages, but by mid-1944 the 76mm gun had lost much of its ability to knock out German tanks. Having sacrificed armor protection and secondary armament, a tank destroyer that could not destroy enemy tanks certainly had a limited utility. Some commands loved the Hellcat for its mobility, others were less charitable. As a result, Buick undertook the conversion of 233 M18s to M39 armored utility vehicles in 1944 and a further 407 in 1945. This was accomplished by removing the turret and opening up the superstructure to carry seven passengers. It served as a command vehicle and a prime mover for the towed 3" AT gun.

The need for a more powerful gun had already been anticipated. In September 1942 the Ordnance Department began working on a modification of the 90mm AA gun that could be used in a tank turret, and such a weapon was fired in trials on a modified M10 in December.

	1941	1942	1943	1944	1945
M6 Motor Gun Carriage, 37mm	-	5,380	-	-	-
M10 Motor Gun Carriage, 3-inch	-	611	4,382	-	-
M10A1 Motor Gun Carriage, 3-inch	-	28	1,685	-	-
M18 Motor Gun Carriage, 76mm	-	-	812	1,695	-
M36 Motor Gun Carriage, 90mm*	-	-	-	1,213	200
M36B1 Motor Gun Carriage, 90mm	-	-	-	187	-
M36B2 Motor Gun Carriage, 90mm*	-	-	-	-	724

* conversions

Tank Destroyer Production (excl half-track) by Year



Turning it into a workable vehicle, however, took longer. A whole new turret was required and the finished prototype, designated the T71, was not available until September 1943. In October Army Ground Forces requested the production of 500 T71s and the termination of production of the M10. This decision was partly the result of a cut-back in the number of tank destroyer units to be raised. At that time the Army had a requirement for 2,862 tank destroyers, but with existing and forecast production of 11,547.

Dropping new turrets on the M10 chassis proved a bit more difficult than originally thought, but in April 1944 Fisher began taking 300 incomplete M10A1 chassis on their production line and completing them as T71s, standardized as the M36 motor gun carriage in July. The other 200 vehicles of the initial order came from conversion of existing M10A1s taken from depot stocks. The fighting in Normandy pressed home the need for 90mm vehicles, and American Locomotive converted a further 413 M10A1s to M36s by the end of the year. In addition, Fisher began building vehicles using new production M4A3 Sherman hulls, yielding the M36B1. Starting in May 1945 Montreal Locomotive converted 200 more M10A1s to M36s, but this exhausted the stock of available vehicles. The only alternative was to start using the hulls of the diesel-powered M10 and this was begun in May as well, to yield the M36B2.

The M36 with its big gun proved immediately popular. In fact, it was so often used as a tank that Army Ground Forces directed the development of an overhead armor cover kit for the open-topped turret, a point of particular vulnerability. In addition, the ETO requested development of a version with bow and coaxial machine guns, which would have completed the transformation into a tank (although the few M36B1s built had a bow machine inherited from its Sherman hull).

The US tank destroyer effort cannot be considered a success. The M10 provided nothing that the 76mm Sherman could not and was far more specialized. The M18 was fast and the M36 powerful, but both served mainly to highlight what could have been accomplished had the effort that went into developing them been used to develop improved tanks. Indeed,

by the end of the war the M36 was the tank that the Sherman could have and should have been.

Marmon-Herrington Tanks

The one producer of armored vehicles operating outside the framework of War Department suppliers was the Marmon-Herrington Company of Indianapolis. In the mid-1930s they decided to try their hand at tanks. Their initial effort was the CTL-3, a two-man turretless vehicle with three .30cal machine guns ball-mounted in the superstructure. The US Marines bought five of these vehicles in June 1936, largely because they were the only tank-like vehicles available within their 5-ton limit. A slightly improved version, with a more powerful engine, was developed as the CTL-3A, and the Marines bought five of these in December 1937. The suspension components proved troublesome, however, and a further improved version, using the track and running gear of the M2A4 light tank, was introduced in 1941 as the CTL-6. The Marines purchased 20 of these vehicles that year, and retrofitted the CTL-3s with a wider track. This was the last procurement of these near-useless little vehicles. Also purchased were five CTM models with twin .50cal machine guns in a turret. Two tank companies were sent to the Wallis Islands and British Samoa, abandoning the useless vehicles there when the units returned home in 1943.

The company also launched an export drive, and the most notable recipient of their attentions was the KNIL, the Netherlands East Indies Army. Efforts in the late 1930s proved fruitless, but when the war in Europe broke out Marmon-Herrington found itself in the enviable position of being the only available producer. To expand their product range they developed a turreted version of their light tank, known as the CTLS. This vehicle had a two-man crew, a small turret offset to one side, and armed with two .30cal machine guns, one in the turret and one in the hull. Because the driver's position blocked the turret in a 120° arc, the tank was available in two configuration: the -4TAC with the driver to the right and the -4TAY with the driver to the left. The tanks were to operate in pairs to avoid blind spots. An enlarged version of the CTLS was also proposed, a three-man tank with a turret-mounted 37mm gun called the CTMS-1TBI, and an even larger version, the MTLS-1GI4, a

four-man tank with a bizarre twin 37mm gun mounting in the turret. Lacking any other available source, the KNIL ordered an initial 200 CTLS and 120 CTMS in the autumn of 1940, followed by a further 34 CTLS, 74 CTMS and 200 MTLS in the Spring of 1941.

Some 165 CTLS and 140 CTMS were to have been delivered by the end of 1941, but the programs were attended by continual delays, apparently caused by the inexperience of both parties involved in specifying, designing and building modern tanks. Although the firm could report that it had delivered 168 tanks (all CTLS) by the end of January 1942, getting them to Java was another matter and only about two dozen appear to have arrived.

Of the remainder, the Australian Army received 149 CTLS that were already en route. This left 39 CTLS on the contract, which the Dutch shipped to Surinam and the West Indies. The US took over the CTMS and MTLS contracts just as production of the former was starting, but although their obsolescence was recognized, bureaucratic inertia allowed production of the full lot of CTMS and 125 of the MTLS before the contracts were cancelled. Designed to accept the American Ordnance 37mm L/44 gun, the small turrets on the CTMS could not accept the larger standard 37mm M5 or M6 tank gun, so they could not be used in the US Army. The more powerful gun could be fitted to the MTLS (in lieu of the twin 37mm mount), but only after a new mounting was designed, an option that was rejected. In the end, the Dutch received 31 CTMS and 19 MTLS for Surinam and the West Indies. The US made a half-hearted effort to dispose of the inherited vehicles by lend-lease, shipping eight CTMS to Cuba, 12 to Ecuador, six to Guatemala and four to Mexico, but this was stopped in 1944 and the remainder scrapped.

The company's other (temporary) export success was to China. In May 1941 the US ordered 240 CTLS light tanks for China's Lend-Lease account. In early March 1942, about the time the first tank was coming off the production line, China declared them unsuitable and refused to accept them. The last tank of the batch was completed in July and the US was left with 240 of these little machines. The US Army designated them the T-14 (right



Left: An M3 half-track personnel carrier in Morocco in 1942. Note the exhaust extension used in landing operations still has not been removed

The half-tracks were generally successful vehicles. Such limitations as they had, notably the inability to keep up with tanks in rough terrain, were due to the general half-tracked configuration. Thus, there were few changes to the design during the war. The M4 mortar carrier was designed to accommodate the mortar for transport, with firing on board envisioned only as an emergency measure. As a result, no traverse, other than the 130 mils on the mortar crank, was provided. Mounted firing proved popular in combat, however, so provision was made on the floor mount for traversing the mortar a greater amount, and this revised vehicle was designated the M4A1 in January 1943. Most M4s were converted to M4A1 standard, a relatively simple operation. The primary limitation of the M4 and M4A1 vehicles was that they fired to the rear. To remedy this a new vehicle was designed, this time based on the larger M3 personnel carrier, in which the mortar fired to the front. Also added was a pedestal in the rear of the vehicle for a .50cal machine gun. This became the M21, although relatively few were built.

The only major modification to the basic family of half-tracks was the addition of a "pulpit" ring mount for the .50cal machine gun over the right side of the cab. With this an "A1" was added to the designations of the M2, M3, M5 and M9. In addition to new production switching over to this standard, 1,261 M2s and 2,209 M3s were converted to the A1 model.

A versatile vehicle, the half-track family was used as the basis for a wide variety of self-propelled mounts. The earliest of these placed the 75mm M1897 gun in an armored shield firing forward over the cab as the M3 75mm Motor Carriage. Their armor was too thin for the assault gun role and the gun too weak for effective anti-tank work, but they proved useful for direct fire support and, in the early stages of the war, were all the US had. Of the 2,200 built, 1,360 were converted to M3A1 personnel carriers in 1944-45 when their usefulness had finally ended, although they remained popular with British armored car regiments to the end of the war. Similar arrangements mounted the 57mm anti-tank gun as the T48 motor gun carriage and the

hand turret) and T-15 (left hand turret) and issued some of them briefly to units in Alaska. They were withdrawn in 1943 and scrapped. Thereafter, the firm turned to the production of a US Army tank, the T-9 (M22).

Staying outside the mainstream of US tank development, Marmon-Herrington had provided little to aid the war effort. During 1936-45 they had built over 1,600 tanks for the US and allies, all of them substandard, and of which about 50 actually saw combat.

Half-Tracks

Although the US had experimented with half-track trucks through the 1930s the first use of that configuration on armored vehicle did not come until the White T7 half-track personnel carrier, derived from the M3 scout car, which underwent tests in September-October 1938. The provision of power to the front axle improved its mobility compared to earlier vehicles, but it was found to be underpowered. An improved version, the T14, underwent trials in 1939. Further modifications led to standardization of three vehicles in October

1940, the M2 half-track car, the M3 half-track personnel carrier, and the M4 half-track 81mm mortar carrier. All three were identical in terms of automotive components and were externally identical except that the M3 was 25cm longer. The M2 and M4 were immediately placed in large-scale production with White and Autocar, and the M3 with those two and Diamond T.

Further, massive procurement was authorized after the Pearl Harbor attack, but current capacity was already strained. In early 1942 the International Harvester Co. offered to place its entire truck manufacturing facilities at the Army's disposal for half-track building, but only if the firm could use many of its own components. After trials the I-H models were accepted for service as the M9 (equivalent of the M2) and the M5 (equivalent of the M3). The frame, suspension, transmission and external appearance of the M9/M5 were identical to their earlier equivalents, the differences being in the engine, front axle and the use of homogenous welded armor plate. Because they used a non-standard engine most were handed out as international aid.



	1940	1941	1942	1943	1944	1945
Car, Half-Track, M2	-	3,565	4,735	3,115	-	-
Car, Half-Track, M2A1	-	-	-	987	656	-
Car, Half-Track, M9	-	-	-	2,026	-	-
Car, Half-Track, M9A1	-	-	-	1,407	-	-
Carrier, Personnel, M3	-	1,859	4,959	5,681	-	-
Carrier, Personnel, M3A1	-	-	-	2,037	1,638	920
Carrier, Personnel, M5	-	-	152	4,473	-	-
Carrier, Personnel, M5A1	-	-	-	1,859	1,100	-
Carrier, Mortar, M4	-	1	571	-	-	-
Carrier, Mortar, M4A1	-	-	-	600	-	-
Carrier, Mortar, M21	-	-	-	-	110	-
Carriage, 57mm Gun, T48	-	-	50	912	-	-
Carriage, 75mm Gun, M3	-	86	1,350	766	-	-
Carriage, 75mm How, T30	-	-	500	-	-	-
Carriage, 105mm How, T19	-	-	324	-	-	-
Carriage, twin 20mm, T10E1	-	-	-	-	110	-
Carriage, twin .50cal, M13	-	-	-	1,103	-	-
Carriage, twin .50cal, M14	-	-	5	1,600	-	-
Carriage, multiple gun, M15	-	-	80	600	-	-
Carriage, multiple gun, M15A1	-	-	-	1,052	600	-
Carriage, multiple gun, M16	-	-	-	2,323	554	-
Carriage, multiple gun, M17	-	-	-	400	600	-

Production of Half-Track Vehicles by Year

75mm pack howitzer as the T30. The former was intended as a tank destroyer (a role it performed indifferently at best) and the latter as an expedient pending production of the tank-based M8 SP. The bulk of the T48s were exported as international aid, 30 to the UK and 650 to the USSR. The remainder were converted to M3A1 personnel carriers in 1944.

On the other hand, half-tracks provided the basis for all the US self-propelled anti-aircraft guns. The first of these involved placing a twin .50cal MG Maxson mount on the rear of the M3, resulting in the M13 gun carriage. A similar design, but using the M5 as the vehicle, was designated the M14. Two approaches were taken to improve the firepower of these vehicles. The first involved switching to a quad .50cal arrangement to yield the M16 gun carriage (when using the M3 vehicle) and the M17 (on the M5). The second approach involved designing a new mount that carried a 37mm anti-aircraft gun and two .50cal MGs. That mount, on the M3 chassis, yielded the M15 gun carriage and, with a slightly modified mount, the M15A1. Although there was little air opposition by the time these vehicles entered service the M15, M16 and M17 all proved very

popular and effective in the ground-support role. A project was also launched to fit a twin 20mm mount on the M3 chassis and 110 were ordered, but only one was completed with guns, the other 109 being converted to M16s (along with 568 twin-gun M13s).

The sole use of the half-track chassis as a true artillery system came with the installation of the 105mm M2A1 howitzer in place of the 75mm gun of the M3 gun carriage to result in the T19 105mm gun carriage. This overloaded the vehicle, resulting in a loss of mobility and

reliability, but it did provide the armored division artillery with SP weapons until the arrival of the M7 full-tracked vehicle.

Armored Cars

The perceived importance of armored cars in the United States fluctuated considerably during the pre-war period, with brief bouts of intense activity followed by periods of indifference. Twelve models of armored cars were developed during 1928-34 (including two commercial models for the Persian government), but no substantive production was undertaken. Two of these, the Armored Car T1 and the Cavalry Scout Car T1, were simply Pontiac car chassis and bodies with armored radiator covers and machine gun mount. The T6, T7 and T8 armored cars were built on 4x2 commercial truck chassis by Holabird QM depot and were armed with turret-mounted machine guns. Three models were built by commercial firms under Ordnance Department guidance, the T2 by Cadillac, the T10 by Willys, and the T4 by Cunningham. The last-mentioned was a 6x4 design weighing 5 tons with 9mm of armor and a turret with coaxial .50cal and .30cal machine guns. It was the first armored car to be fully standardized, being designated the M1 armored car in 1933.

The final pre-war design was the T11, first built in 1933 by the Four Wheel Drive Corp. With 4x4 drive, a turret-mounted .50cal MG, and 6mm of armor, it represented state-of-the-art at the time but suffered cooling problems and mechanical weaknesses. The T11E1 was a slightly modified version made by Marmon-

	1932	1933	1934	1935	1936	1937	1938	1939	1940
Armored Car, M1 Cunningham	-	28	-	-	-	-	-	-	-
Armored Car, T11	-	-	6	-	-	-	-	-	-
Armored Car, T11E1	-	-	-	6	-	-	-	-	-
Armored Car, T11E2	-	-	-	-	1	-	-	-	-
Scout Car, T7	-	-	-	76	-	-	-	-	-
Scout Car, T9	-	-	-	-	20	-	-	-	-
Scout Car, M2	-	-	-	-	-	2	-	-	-
Scout Car, M3	-	-	-	-	-	-	74	-	-
Scout Car, T13	-	-	-	-	-	-	38	-	-
Scout Car, M3A1	-	-	-	-	-	-	-	825	-

Pre-War Production of Armored Cars & Scout Cars by Fiscal Year



	1941	1942	1943	1944	1945
Scout Car, M3A1	1,908	7,046	10,174	941	-
Scout Car, Canadian ^a	-	320	749	-	-
Armored Car, M8	-	-	4,299	3,383	841
Armored Car, T17	-	32	218	-	-
Armored Car, T17E1	-	157	2,687	-	-
Armored Car, T17E2	-	-	211	789	-
Armored Car, T18E2	-	2	28	-	-
Armored Utility Car, M20	-	-	1,624	1,337	830

^aCanadian production

War Time Production of Armored Cars & Scout Cars

Herrington, followed by the same firm's T11E2. Apparently none of the modifications solved the cooling problem. In any event, shortly thereafter armored cars fell out of favor again and on 14 January 1937 the Army officially cancelled all requirements for such vehicles.

Exempted from this order were the very useful family of new scout cars developed by White Motors. Starting with the T7, these 4x4 open-topped vehicles were initially designed for the reconnaissance role, but found their true calling as jacks-of-all-trades in almost all Allied armies during the war.

The German campaign in France brought armored cars back into favor but, of course, there were no designs available. In January 1941 a firm called the Trackless Tank Corp. proposed a large 8x6 vehicle, resulting in a contract for 17 trials vehicles to be designated the T13 armored car. Although the T13 performed well from an automotive perspective, it was found far too large and heavy for a reconnaissance vehicle and subject to frequent mechanical failures, and development was terminated in July 1942.

To complement the large T13 a requirement was drafted in mid-1941 for a smaller vehicle to be designated the T17. In response to the requirement Ford proposed a 6x6 vehicle (designated the T17) and Chevrolet a 4x4 model (designated the T17E1). The 14-ton T17 was armed with a 37mm gun in a stabilized mount in a powered turret and in January 1942 production of 2,260 was authorized, with another 1,500 vehicles in June. Subsequent tests, however, were disappointing and in December the program was terminated, although Ford was authorized to build 250 vehicles to bridge production until the M8 design was finalized. These 250 vehicles were

offered to the British, who declined them after desert tests, and they were eventually handed over to the Military Police (minus their main guns) for use in the US.

The saga of the T17E1 was only slightly different from that of the T17. The Army authorized production of 2,000 in January 1942, and 1,500 in April, the latter including 300 requested by the British. Although the vehicle proved more reliable in desert tests than the T17, none of the US combat arms declared an interest in the vehicle and termination was recommended in December 1942. The British, however, were willing to accept the vehicle and consequently took over all vehicles under contract. Needing an anti-aircraft vehicle, the British directed the replacement of the normal 37mm gun turret with a Frazier-Nash turret with twin .50cal machine guns (as used on British motor torpedo boats) as the T17E2. 500 of the T17E1s were completed as T17E2s and an additional 500 T17E2 were ordered. Production of the T17E1 was completed in December 1943 and for the T17E2 in April 1944.

The termination of the heavy (T13) and medium (T17/T17E1) projects left the US Army with no armored cars in development. All was not bleak, however, for the Tank Destroyer Board had reluctantly come to the conclusion that a series of 37mm-armed wheeled, armored tank destroyers they had commissioned in development, the T21 and T22 series, were no longer adequate for that role. The 6x6 Ford T22 was found suitable as a reconnaissance vehicle and after modification as the T22E2 was accepted for service as the M8 armored car in June 1942.

The production contract, covering 5,000 vehicles, was placed with Ford in May 1942 but

a dispute over contract terms delayed production until early 1943. In the meantime, development had begun on a utility version of the vehicle, for which purpose the turret was removed and the side walls extended 38cm higher to form a rectangular crew compartment for five to seven men. Production of the resulting vehicle, the M20 armored utility car, was begun by Ford in July 1943.

Self-Propelled Artillery

The March 1942 organization tables for the armored force included self-propelled 105mm howitzers as armored division artillery, but no such vehicles existed, except as prototypes. As a stop-gap measure some 105mm howitzers were placed into half-tracks with production starting in January 1942, but it was clear from the start that this was acceptable only as an interim solution. The armored force had requested the development of such a weapon on the chassis of the M3 medium tank and tests began in February 1942. In April the vehicle was standardized as the M7 motor howitzer carriage. Being based on a medium tank chassis the resultant vehicle was rather heavier than needed for a 105mm howitzer, but it proved sturdy and reliable. The main drawback was the limited elevation of the piece, a result of an unwillingness to accept a higher profile on the vehicle. While American Locomotive was building the M7s a parallel effort was undertaken by Pressed Steel, starting in 1944, that used the Ford engine of the M4A3 medium tank. Otherwise identical to the M7, this was designated the M7B1. The M7 and M7B1 served through the war as the standard US SP field artillery piece.

The prospect of mounting the 105mm howitzer on the M24 chassis promised lighter weight and higher speed and, with more time available for development, a better integrated weapon. Tests began in early 1944 and in January 1945 the vehicle was type classified as the M37 motor howitzer carriage. A small number were built but the war ended before any were deployed overseas.

The companion piece to the 105mm howitzer was the 155mm M1 howitzer. Surprisingly, no serious effort was made to develop an SP mount for this weapon until January 1944 when development of the T64E1



Right: An M7 SP 105mm Howitzer near Soissons, France, in August 1944

carriage was approved and a contract issued to Cadillac in May. The prototype, based on the chassis of the M24 light tank, was tested in early 1945 and in June it was standardized as the M41 motor howitzer carriage. Production was begun at Massey Harris, but none was shipped overseas before the end of the war.

Although the 155mm howitzer was neglected as a candidate for self-propelled traction, the 155mm gun was not. The Ordnance Department had begun studies on the practicality of mounting the 155mm M1918 gun on the M3 medium tank chassis in June 1941. The pilot model, designated the T6, began tests in February 1942. The vehicle performed well and a contract was placed with Pressed Steel for 50 vehicles (later increased to 100) now known as the M12. Simultaneously, a contract was placed for an identical number of unarmed vehicles to serve as ammunition carriers under the designation M30 Cargo Carrier. Nevertheless, Army Ground Forces was never very keen on the vehicles and they sat in storage until the build-up for the Normandy invasion started. In early 1944 74 M12 guns and a similar number of M30 Cargo Carriers were taken out of storage and remanufactured by Baldwin Locomotive and shipped to Europe, where they performed well.

The success of the M12 finally spurred AGF to action, although belatedly. There were no more of the old M1918 guns left in storage and tests showed that the M12 chassis could not stand the recoil of the more powerful M1 gun of similar caliber, so a new start was called for. The overall configuration of the M12, with the



engine in the center and the gun at the rear in an open position, was retained but was built using a lengthened and widened late model Sherman hull. The resulting vehicle was designated the T83 motor gun carriage, standardized as the M40 in May 1945. A slightly modified version was designed to accommodate the 8" M1 howitzer as the T89, but it was not standardized as the M43 until November 1945. One T83 and one T89 were shipped to the ETO in the Spring of 1945 for combat trials, which proved successful, but the war ended before others could see action.

Only one full-tracked SP anti-aircraft gun was fielded, the M19. This followed from a series of experiments with mounting various

weapons on the successful M24 light tank chassis. The configuration finally chosen was the T65E1, in which the engine was moved to the center of the vehicle and an open turret with two 40mm Bofors guns was sited at the rear. The vehicle was standardized as the M19 in June 1944 but production at Cadillac did not begin until April 1945. The end of the war terminated the program at 300 vehicles, all but one of which had been delivered without turrets (which were fitted to a revised design post-war).

Amphibians

A 1937 demonstration of a novel tracked amphibious vehicle by Donald Roebling Jr. excited the Marine Corps, who suggested a series of improvements and modifications, but generated distrust and dislike on the part of the Navy Department, who fought against such a vehicle for the next six years. Finally, in November 1940, the Marines got permission to purchase 200 vehicles, designed the LVT-1 (landing vehicle, tracked), and other similar orders followed but it was not until September 1942 that the first major contract, for 1,900 vehicles, could be placed. The LVT-1 was followed in production by the larger and more reliable LVT-2.

The initial LVTs were made of mild steel and

	1941	1942	1943	1944	1945
105mm How Motor Carriage M7	-	2,028	786	500	176
105mm How Motor Carriage M7B1	-	-	-	664	162
105mm How Motor Carriage M37	-	-	-	-	51
155mm How Motor Carriage M41	-	-	-	-	55
155mm Gun Motor Carriage M12	-	60	40	-	-
155mm Gun Motor Carriage M40	-	-	-	-	418
8" How Motor Carriage M43	-	-	-	-	48
40mm (AA) Gun Motor Carriage M19	-	-	-	-	300
Cargo Carrier, M30	-	60	40	-	-

War Time Production of Full-Tracked Self-Propelled Artillery



Left: An LVT(A)-4 with the 'Mariarnes kit' of extra machine-guns on Okinawa



were intended solely for logistical tasks. For the assault on Tarawa the Marine units in the field had bolted extemporized armor plating on portions of the vehicles, but this was clearly insufficient if these vehicles were to be included in the assault wave. To permit their use in amphibious assaults, modifications were requested first by the Marines, and then by the Army. The Marine solution was to construct the vehicle of thin armor rather than mild steel, and add a modified version of the M5 light tank turret at the center of the roof. In addition two machine gun positions were cut into the rear deck, with scarf rings and shields for .30cal MGs. Although these vehicles proved useful, the addition of the turret sacrificed their cargo-carrying capability. The Army solution was simply to build the LVT-2 out of armor plate, resulting in an armored amphibious load carrier, albeit unarmed. The USMC vehicles were designated LVT(A)-1 (landing vehicle, tracked,

armored), and the Army versions as LVT(A)-2. The design impetus notwithstanding, both services used both models of these vehicles.

The combination of LVTs and LVT(A)s provided US forces in the Pacific with unparalleled capabilities in amphibious warfare. The vehicles were not without shortcomings, however. In the LVT-1 and 2 the engine was mounted at rear, so the only way to load and unload personnel and cargo was over the sides, a considerable problem in a vehicle 3 meters high. This was solved in the LVT-4, where the engine was moved forward and a ramp installed in the rear for loading and unloading. The LVT(A)s were huge and thinly-armored, making them easy targets, but there was little that could be done about this without compromising their buoyancy. A problem that was solvable, however, was the weak armament of the LVT(A)-1. The little 37mm gun was almost completely ineffectual against Japanese bunkers.

The solution adopted here was to replace the M5 tank turret with that of the M8 motor gun carriage with its 75mm pack howitzer as the LVT(A)-4. The larger weapon proved much more successful, but installation was not without its costs. The M8 turret did not include a coaxial machine gun and in order to fit the turret the two machine gun pits had to be plated over, leaving the vehicle with no machine guns for self-defense other than the .50cal mounted on an exposed pintle above the turret. Experience showed this to be a severe shortcoming. Later production models modified the rear of the turret by removing the small partial roof and the ring mount with .50cal MG and replacing them with two pintle-mounted .30cal machine guns with gun shields. In addition, a ball-mounted .30cal MG was placed in the superstructure front. No official designation was given to this version, although it was popularly known as LVT(A)-4 Marianas Model. Further improvements added a power traverse for the turret and a gyro-stabilizer for the gun, yielding the LVT(A)-5.

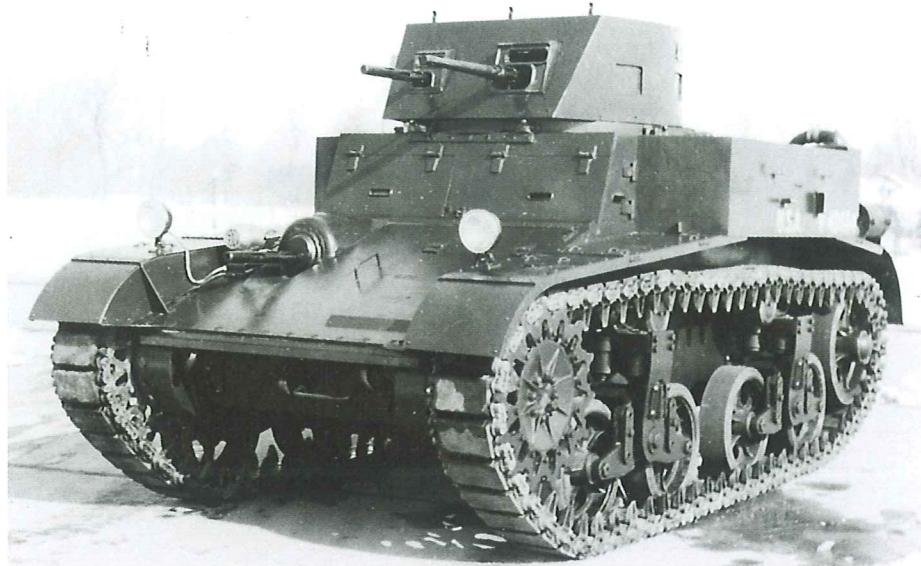
	1941	1942	1943	1944	1945
LVT-1	72	851	302	-	-
LVT-2	-	-	1,540	1,422	-
LVT-3	-	-	1	733	2,230
LVT-4	-	-	11	4,980	3,360
LVT(A)-1	-	3	288	219	-
LVT(A)-2	-	-	200	250	-
LVT(A)-4	-	-	-	1,489	401
LVT(A)-5	-	-	-	-	269

Production of Tracked Amphibians



Combat Cars/Light Tank M1

The M1 combat car had a crew of four: driver, hull gunner, commander and turret gunner. The turret featured a .50cal and a .30cal MG in separate mounts and a 3-section hinged roof that could be folded forward either flat or with a vertical portion as a shield. A second .30cal MG was fitted in the hull front. The M1A1, also known as the Model 1938, introduced a constant mesh transmission. The M2 replaced the Continental gas engine with a Guiberson diesel, dropped the idler down to ground level and used a new turret design. No radio was fitted to either model. The new turret was retrofitted to the M1 fleet as well. In July 1940 the M2 combat cars were redesignated M1 light tanks and the M1 combat cars as M1A1 light tanks. Obsolete by 1940, they never saw combat.



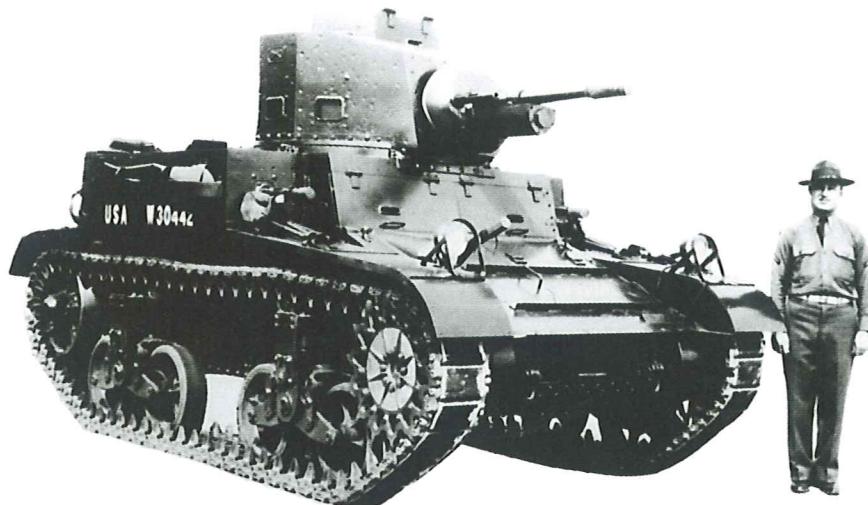
M1A1 Light Tank



Weight (tonnes)	8.9	Front Armor (mm)	16
Length (m)	4.14	Side Armor (mm)	n/a
Width (m)	2.39	Engine HP	250
Height (m)	2.36	Road Speed (km/h)	75

Light Tank M2

The original M2A1 light tank was similar to the M1 combat car, but the two turret weapons were mounted coaxially in a common mount in a circular turret. The M2A2 was a retrograde step with separate small turrets for the two main MGs. The M2A3 retained the twin-turret configuration, but lengthened the suspension to increase ground contact and lower ground pressure. The main production version, the M2A4, featured a single turret with a 37mm gun (with 103 rounds) and coaxial .30cal MG. The gun had 10° of traverse on the mount to facilitate quick engagement. The tank commander doubled as the loader in the two-man turret. A third .30cal was fitted in a ball mount at the hull front, and two more in sponsons facing forward. It also had thicker armor (25mm vs. 16mm) and a slightly uprated engine to compensate. Transceivers were fitted to command tanks and receivers to the others.



Weight (tonnes)	10.5	Front Armor (mm)	25
Length (m)	4.42	Side Armor (mm)	n/a
Width (m)	2.46	Engine HP	250
Height (m)	2.49	Road Speed (km/h)	50

M2A4 Light Tank



Light Tank, M3

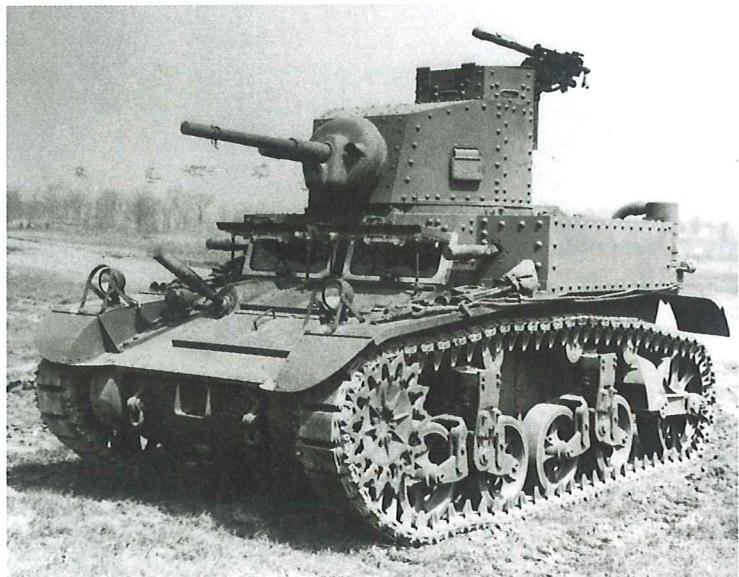
The M3 series of light tanks evolved through a complex process with many variations, most of which were not identified with unique model numbers. The original M3 was of riveted construction and featured two two-wheel bogies on each side and a large trailing idler. It was armed with a 37mm M5 or M6 gun and coaxial .30cal MG in the manually operated turret, a second MG in a ball-mount on the hull front, a third on an AA mount on top of the turret, and two more fixed forward firing in the sponsons, the latter fired by the driver. The turret was manually traversed and the 37mm gun mount provided 10° internal free traverse each side for fine-laying. The commander would manually traverse the turret to the approximate direction of the target, then the gunner would complete the aiming with the free mount traverse. The vehicle was powered by the Continental W-670 seven-cylinder radial engine. Almost simultaneously the tank was also produced with the Guiberson T-1020 diesel. During the production run the riveted turret was replaced by a welded one, and in 1942 a gyrostabilizer was added for the gun. Another change was the switch from the 37mm M5 gun to the slightly longer M6.

For the M3A1 the turret was provided with hydraulic traverse (and the on-mount traverse eliminated) and a turret basket fitted. The cupola was removed from the turret roof and replaced by a periscopic sight. The sponson machine guns were removed as superfluous, a modification already made by the British to their M3s. Once again, there were two main variants, one with W-670 gasoline engine and the other with the Guiberson diesel. In the rush to get tanks to the field some were produced with manual turrets but no free traverse on the mount (known to the British as hybrid Stuarts), rendering them useless.

There was no M3A2, and the M3A3 used the hull design of the M5 light tank, although it retained the W-670 radial engine and thus did not feature the raised rear engine deck characteristic of the latter. In addition, the sponsons of the M3A3 were sloped slightly inward as they rose, affording slightly better ballistic protection, while additional fuel tanks were added there to extend the tank's range. A new turret was also developed for the M3A3, the main difference being a bustle in the rear to accommodate the radio formerly housed in the hull. The gun mount was also redesigned to closer tolerances to reduce dispersion.

The M3 series served the British well as a gun tank in 1941-42, but proved undergunned after that.

	M3	M3A3
Weight (tonnes)	12.5	14.4
Length (m)	4.52	5.03
Width (m)	2.24	2.51
Height (m)	2.51	2.29
Front Armor (mm)	37	37
Side Armor (mm)	25	25
Engine HP	250	250
Road Speed (km/h)	60	60



Above: M3 Light Tank (Gas)



Above: M3 Light Tank (Diesel)



Above: M3A1 Light Tank



Light Tank, M5

This was an evolution of the M3 series of light tanks designed to circumvent a shortage of engines by pairing twin Cadillac automobile engines with hydromatic transmissions. This resulted in a raised engine deck that distinguished the M5 from the M3A3. The turret was essentially the same as in M3A1, with a rotating turret basket and power traverse, although it was a little roomier due to the relocation of some items to the hull floor under the basket. In a reversion to earlier practice a fixed .30cal machine gun was provided in the hull front that was fired by the driver. Dual driving controls were provided for the driver and assistant driver. The M5A1 used a new turret and improved vision devices. The M3 and M5 were fast and reliable, but by late 1942 undergunned. For that reason, from then on they served as reconnaissance vehicles rather than fast tanks.

M5 Light Tank



	Weight (tonnes)	15	Front Armor (mm)	50
	Length (m)	4.34	Side Armor (mm)	28
	Width (m)	2.24	Engine HP	220
	Height (m)	2.29	Road Speed (km/h)	60

Light Tank, M22 (Locust)

This tank was designed by Marmon-Herrington specifically for the airborne forces. The crew of three comprised the driver in the hull, and commander and gunner in the turret. All non-essential features, such as powered turret traverse and gun stabilization, were eliminated to save weight. The armament, consisting of a 37mm M6 gun with a coaxial .30cal MG, represented the worst of two worlds. The small, high-velocity M6 was too small to deal with enemy tanks by the time the tank came into service, yet did not throw a useful HE round either. The US did not have a glider capable of carrying the M22 in any event and never used it in combat. The British Hamilcar glider could carry it and small numbers were used in the 1945 crossing of the Rhine.



	Weight (tonnes)	7.5	Front Armor (mm)	25
	Length (m)	3.94	Side Armor (mm)	25
	Width (m)	2.16	Engine HP	162
	Height (m)	1.85	Road Speed (km/h)	67

M22 Light Tank



Light Tank, M24

The best light tank of the war, the M24 was a complete departure from the earlier US lights. The twin Cadillac engines and Hydramatic transmission provided high speed and the torsion-bar suspension good cross-country mobility. The armament consisted of a 75mm M6 gun (for which 48 rounds were provided) and a coaxial .30cal MG in the turret, a second .30cal in a ball mount, and a .50cal on an AA mount. A 2" smoke mortar was fitted on the turret roof. The commander had a low-profile cupola with six vision blocks and a periscope. Unlike the M3/M5 series it could accommodate the efficient three-man turret crew, and it proved reliable and successful in service. As such, it served well into the post-war years in many armies.

Although large for a reconnaissance vehicle, the M24 was an exceptionally well-balanced design



	Weight (tonnes)	18.4	Front Armor (mm)	25
	Length (m)	5.49	Side Armor (mm)	25
	Width (m)	2.95	Engine HP	220
	Height (m)	2.46	Road Speed (km/h)	58

Light Tank, Marmon-Herrington CTLS

This commercial export tank had a crew of only two: a driver and a commander/gunner. The unconventional design, placing the driver and turret side by side, meant that the driver's hood blocked the traverse of the turret overhead. Thus, two separate models had to be built, the CTLS-4TAC with the driver on the left, and the 4TAY with the driver on the right, so that the tanks could operate in pairs to provide 360° coverage. Firepower, in any event, was weak, consisting of a single light machine gun in the turret (with 240° of traverse) and two more on ball mounts in the hull front in case the driver did not have enough to do to stay occupied. The US Army reluctantly took over a number as the T14 (-4TAY) and the T16 (-4TAC) light tanks. By the time production got under way in late 1941 they were totally obsolete.

A CTLS (right hand turret version) reluctantly taken over by the US Army on maneuvers in Alaska



	Weight (tonnes)	7.2	Front Armor (mm)	13
	Length (m)	3.50	Side Armor (mm)	13
	Width (m)	2.08	Engine HP	146
	Height (m)	2.11	Road Speed (km/h)	52



Medium Tank M2

The archaic design of the M2 medium tank featured a high superstructure with rotors on each corner mounting .30cal machine guns for suppressing infantry all around. Two more such weapons were fixed in the hull front and aimed (by turning the tank) and fired by the driver. Surmounting this was a turret with a 37mm M6 gun and a coaxial machine gun. Ammunition stowage was 200 rounds for the 37mm and no fewer than 12,250 rounds of .30cal. The crew comprised a driver, four gunners and the commander. The main production version, the M2A1 featured a more powerful engine, thicker armor (32mm vs. 25mm) and wider tracks. Obsolete by 1941, the vehicle was used only for training. The automotive components, however, proved a valuable stepping-stone for the M3 and M4 medium tanks

M2 Medium Tank



First column M2,			Height (m)	2.84	2.82
Second column M2A1			Front Armor (mm)	25	32
Weight (tonnes)	17.3	21.4	Side Armor (mm)	n/a	n/a
Length (m)	5.33	5.33	Engine HP	350	400
Width (m)	2.59	2.59	Road Speed (km/h)	43	43

M3 Medium Tank (Lee/Grant)

An interim design, the M3 featured a 75mm M2 (L/28) or M3 (L/38) gun mounted in the hull with 15° traverse each side, a 37mm M5 or M6 gun in the turret, and three .30cal MGs – one fixed in the hull front, one coaxial with the 37mm, and one in a cupola above the turret (tanks built for Britain lacked the cupola). The M3A1 and M3A3 used a welded hull. The basic model used a Wright radial aircraft engine, the M3A3 and M3A5 used a pair of GM truck engines, and the M3A4 the A57 multibank engine which necessitated lengthening the tank by 28cm. The hull-mounted gun was awkward, but the tank served well in 1942 until Shermans became available, and continued to serve in Burma in the infantry support role until the end of the war.

M3 Medium Tank



First column M3, Second column M3A1,			Height (m)	3.12	3.12	3.12
Third column M3A4			Front Armor (mm)	50	50	50
Weight (tonnes)	26.1	26.8	Side Armor (mm)	37	37	37
Length (m)	5.65	5.6	Engine HP	340	340	370
Width (m)	2.72	2.72	Road Speed (km/h)	40	40	40



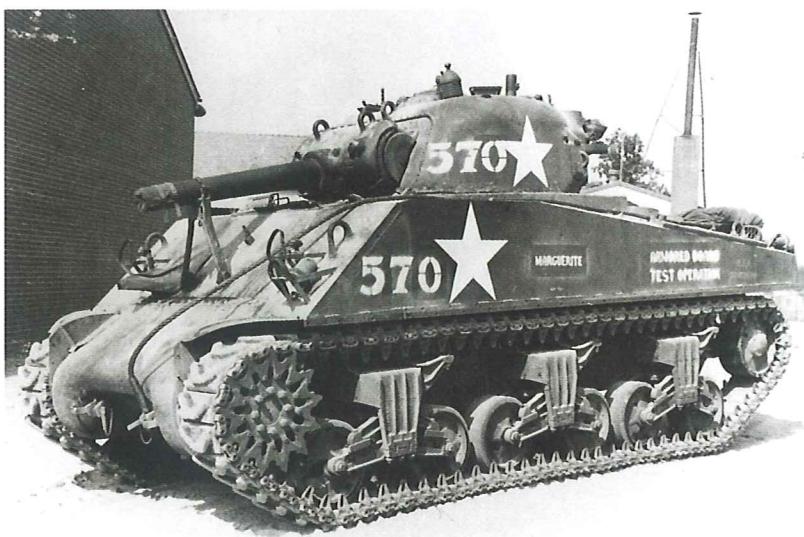
Medium Tank M4 (Sherman)

To facilitate production the Sherman family was produced simultaneously in a bewildering array of variants. The base model M4 had a welded hull and Continental R-975 gasoline engine. The M4A1 was similar, but had a cast hull. The M4A2 was similar to the M4, but used twin General Motors 6-71 diesels in light of shortages of the Continental units. The M4A3 was the M4 but fitted with a special version of the Ford GAA engine. This was the favorite model for the US Army, which kept most of the M4A3s for themselves. The M4A4 had the Chrysler WC multi-bank engine, which necessitated lengthening the rear hull to accommodate this massive unit. The M4A6 was the M4A4 with the Caterpillar RD-1820 radial diesel.

The basic version of each of these was armed with a 75mm M3 gun (for which 97 rounds were stowed) and a coaxial .30cal MG in the turret, a second .30cal MG in a ball mount on the hull front, and a .50cal MG on an AA pintle mount on the turret roof. The crew consisted of the commander, gunner and loader in the turret, and the driver and bow machine gunner in the hull. In January 1944 production started on versions of the A1, A2 and A3 with 76mm M1 guns. These used a different turret that had been developed for the abortive T23 tank and carried 71 rounds of main gun ammunition in wet stowage.

For high-explosive fire support versions of the basic M4 and M4A3 were fitted with a 105mm howitzer (with 66 rounds) in lieu of the 75mm gun. The power turret traverse was deleted in these models. Within each or some variants detail improvements were cut in during the production run, including appliqué side armor, wet ammunition stowage, Horizontal-Volute Spring Suspension with wider tracks in the E8 variant of several models for better cross-country performance, etc. The Sherman was easy to produce and very reliable, but suffered from being undergunned and the narrow tracks caused it to sink in muddy ground.

	M4	M4A3	M4A4
Weight (tonnes)	28.5	28.4	29.7
Length (m)	5.89	5.89	6.04
Width (m)	2.62	2.62	2.62
Height (m)	2.74	2.74	2.74
Front Armor (mm)	50	75	75
Side Armor (mm)	37	37	37
Engine HP	350	450	370
Road Speed (km/h)	40	43	40



Top: Early production M4A4 with 75mm gun

Middle: The US Army's favorite — The M4A3E8 with HVSS and 76mm gun

Bottom: A late-production M4 (105mm howitzer) medium



M26 Heavy Tank

The only member of the T20-series of projects to see service use, the M26 used the torsion-bar suspension characteristic of most late-war US tanks. The tank was armed with a 90mm M3 gun and coaxial .30cal MG in the turret, a second .30cal MG in a bow mount, and a .50cal weapon on an anti-aircraft mount on the turret. Although the M3 gun was not nearly as powerful as the 88mm L/71 mounted in some German vehicles, the improvement compared to the earlier 75mm and 76mm weapons guaranteed it would be popular. Opposition from within the Army, however, delayed its introduction so that it was only used in small numbers in the closing months of the war in Europe and on Okinawa. Its main weakness was the lack of a suitable engine that left the vehicle underpowered, especially noticeable on hilly terrain.

M26 Heavy Tank



	Weight (tonnes)	41.8	Front Armor (mm)	102
	Length (m)	8.79	Side Armor (mm)	76
	Width (m)	3.51	Engine HP	500
	Height (m)	2.78	Road Speed (km/h)	44

M10 Motor Gun Carriage (Tank Destroyer)

This vehicle used the chassis and power pack of the M4A2 (M10) or M4A3 (M10A1) Sherman, on which was mounted a superstructure with thinner armor than the tank and a turret carrying a 3" M7 gun and a pintle-mounted .50cal AA MG. Although the gun was better than the US 75mm tank gun and adequate for its time, the vehicle was not terribly popular. The reduced armor thickness did not buy an appreciable improvement in mobility, the lack of power turret traverse slowed engagement speed, and the absence of a coaxial or bow machine gun left it very vulnerable to enemy infantry. Nevertheless, it was the most numerous tank destroyer and served until replaced by M18s and M36s. The British rearmed a portion of their lend-lease M10s with the superior 17pdr gun to yield the Achilles.



	Weight (tonnes)	30	Front Armor (mm)	50
	Length (m)	5.97	Side Armor (mm)	25
	Width (m)	3.05	Engine HP	375
	Height (m)	2.46	Road Speed (km/h)	50

M10 Motor Gun Carriage



M18 Motor Gun Carriage (Tank Destroyer)

With this vehicle the engineers sacrificed almost everything for high speed, both on the road and, with its torsion-bar suspension, cross-country. Fast it certainly was, but the side armor could be penetrated by .30cal AP ammunition at close range, the open-topped turret left it vulnerable to artillery air bursts and it lacked any machine guns other than the .50cal AA mount. Its 76mm M1 gun had lost much of its "sting" by mid-1944, so the standard tactic was to use the vehicle's mobility to try to get flank shots against superior German tanks. These faults notwithstanding, the M18 "Hellcat" proved popular with the crews, probably due in no small measure to the comparison with the M10, compared to which it was not only faster, but had power traverse for the turret.



M18 Motor Gun Carriage

	Weight (tonnes)	18.2	Front Armor (mm)	12
Length (m)	5.28	Side Armor (mm)	12	
Width (m)	2.97	Engine HP	400	
Height (m)	n/a	Road Speed (km/h)	83	

M36 Motor Gun Carriage (Tank Destroyer)

To get the M36 the Army took uncompleted or depot-stock M10A1 tank destroyers and fitted them with a new turret mounting the 90mm M1 gun. As with the other tank destroyers, the only machine gun armament was a .50cal weapon on an AA mount. The turret had power traverse and, initially, an open top. A light armor cover retrofit kit was developed for fielded vehicles and later production vehicles featured a folding armor top on the turret. The M36B1 used the chassis of the M4A3 tank (complete with bow machine gun), while the M36B2 used the hull of the diesel-powered M10. The use of a new turret that did not need the counterweights required by the M10 actually made the M36 a ton lighter than that vehicle. The M36 was very popular with the troops as the only vehicle capable of dealing with the more modern German tanks in 1944.



M36 Motor Gun Carriage at speed

	Weight (tonnes)	26.4	Front Armor (mm)	55
Length (m)	5.97	Side Armor (mm)	25	
Width (m)	3.05	Engine HP	375	
Height (m)	2.72	Road Speed (km/h)	50	



Howitzer Motor Carriage M7

The standard self-propelled artillery piece of the US Army, the M7 mated the 105mm M1A2 or M2 howitzer with the chassis of the M3 medium tank with its Continental R-975 engine. The main gun could traverse 15° left and 30° right, and could elevate from -5° to +35°, and 69 rounds were carried. Secondary armament was a .50cal MG in a pintle mount at the right front. The vehicle was crewed by the commander, driver and five gun crew. The open top and low sides limited crew protection. The M7B1 switched to the chassis (and Ford engine) of the M4A3 Sherman, which had replaced the M3 in production. Being based on a medium tank chassis the M7 was heavy for the piece it carried, but it also inherited the reliability of the M3/M4 family and proved popular in service.



Late-production M7 Howitzer Motor Carriage

	Weight (tonnes)	19.9	Front Armor (mm)	12
	Length (m)	6.02	Side Armor (mm)	12
	Width (m)	2.87	Engine HP	350
	Height (m)	2.54	Road Speed (km/h)	40

Howitzer Motor Carriage M8

This was essentially the M5 light tank with the turret replaced by a larger open-topped unit armed with a 75mm M2 or M3 howitzer to provide mobile fire support. The barrel of the howitzer was surrounded by a large flash deflector tube that extended beyond the muzzle. The weapon could elevate from -20° to +40° and 46 rounds were carried. The two-man turret crew comprised the gunner on the left and the loader on the right. The driver and assistant driver (with duplicate controls) sat at the front. Those two entered and exited via the larger turret and no hatches were provided for them. The sole secondary armament was a .50cal MG on a ring mount at the right rear of the turret. The M8s served in tank battalions until 1944 when they were replaced by 105mm howitzer-armed Shermans.



M8 Howitzer Motor Carriage

	Weight (tonnes)	16.4	Front Armor (mm)	30
	Length (m)	4.34	Side Armor (mm)	25
	Width (m)	2.24	Engine HP	220
	Height (m)	2.29	Road Speed (km/h)	60



Gun Motor Carriage M12

This vehicle used the chassis of the M3 medium tank (albeit with M4-style bogies) with the engine moved from the rear to the center of the vehicle. This left a platform at the rear on which was mounted the old 155mm M1917, M1917A1 or M1918M1 gun (depending on availability) with a traverse of 14° each side and an elevation of -5° to +30°. The driver and commander sat inside the hull at the front, two sat to the left of the gun, and two on seats on the hinged spade at the rear. Only 10 projectiles and charges could be carried on the M12, so a similar vehicle, but without the gun, was built as the M30 to carry ammunition and gun crew. The vehicles thus served in pairs, one M12 and one M30 per gun section.



M12 Gun Motor Carriage firing

	Weight (tonnes)	26.4	Front Armor (mm)	50
Length (m)	6.73	Side Armor (mm)	20	
Width (m)	2.67	Engine HP	350	
Height (m)	2.69	Road Speed (km/h)	40	

Gun Motor Carriage M13/M14/M15/M16

The M13 was an M3 half-track fitted with hinges on the upper parts of the side and rear plates to fold down, and a Maxson twin .50cal turret on the rear bed. The M14 was similar, but used the M5 half-track as the carrier vehicle. The M16 was the M13 but with a quad .50cal Maxson mount, while the M17 was the quad-mount version of the M14. In all cases traverse (360°) and elevation (-10° to +90°) is electrical. Each gun fired at 400-500 rounds/minute. Crew consists of the commander, driver, gunner and two loaders. The M15 gun motor carriage used the chassis of the M3 personnel carrier fitted with an M42 combination mount. This manual mount carried a 37mm M1A2 gun and two .50cal machine guns. The M15A1 incorporated improvements to the gun mount. All these vehicles were limited or substitute standard except the M16, which was the standard air defense vehicle for the US Army to the end of the war.

M16 gun motor carriage with quad .50 cal machine guns



First column M15, Second column M16		Height (m)	2.39	2.34
Weight (tonnes)	9.45	Front Armor (mm)	12	12
Length (m)	6.17	Side Armor (mm)	0	12
Width (m)	2.24	Engine HP	128	128
	2.16	Road Speed (km/h)	67	67



Gun Motor Carriage M3

An expedient tank destroyer and fire support vehicle, the M3 mounted the 75mm M1897A4 gun on the M3 mount, adapted from the M2A3 carriage, on the M3 half-track body. Elevation was -10° to $+29^{\circ}$ and traverse 19° left and 21° right. 59 rounds of HE and AP/APC ammunition were carried. No machine gun armament was fitted. The M3A1 gun motor carriage was identical, but used the M5 mount, which reduced minimum elevation to -6.5° but gave 21° traverse each side. The crew consisted of the commander, driver, gunner and two gun crew. The gun was marginal for the tank destroyer from 1942, and was replaced by full-tracked vehicles, being declared obsolete in September 1944. It remained useful in the general support role and the British used it for that purpose to the end of the war.

M3 gun motor carriage



	Weight (tonnes)	9.09	Front Armor (mm)	12
	Length (m)	6.22	Side Armor (mm)	8
	Width (m)	2.16	Engine HP	128
	Height (m)	2.51	Road Speed (km/h)	75

Half-Tracks M2, M3, M5, M9

The original half-track family consisted of three vehicles sharing automotive components, the Half-Track Car M2, the Half-Track Personnel Carrier M3, and the Half-Track Mortar Carrier M4. The vehicles were identical in all important respects except that the chassis of the M3 was 25cm longer to allow the carriage of 13 men. The M4 was designed initially only for emergency onboard firing of the mortar toward the rear. The M4A1 added an arc-shaped plate on the floor to give additional traverse. The M2 was armed with a .50cal and two .30cal MGs,



Above: An M2 half-track car being used as a reviewing stand pre-war

First column M2,

Second column M3,

Third column M5

Weight (tonnes)	9.0	9.1	9.3
Length (m)	6.12	6.32	6.32
Width (m)	1.96	1.96	1.96
Height (m)	2.26	2.26	2.31
Front Armor (mm)	12	12	12
Side Armor (mm)	8	8	12
Engine HP	128	128	143
Road Speed (km/h)	67	67	63

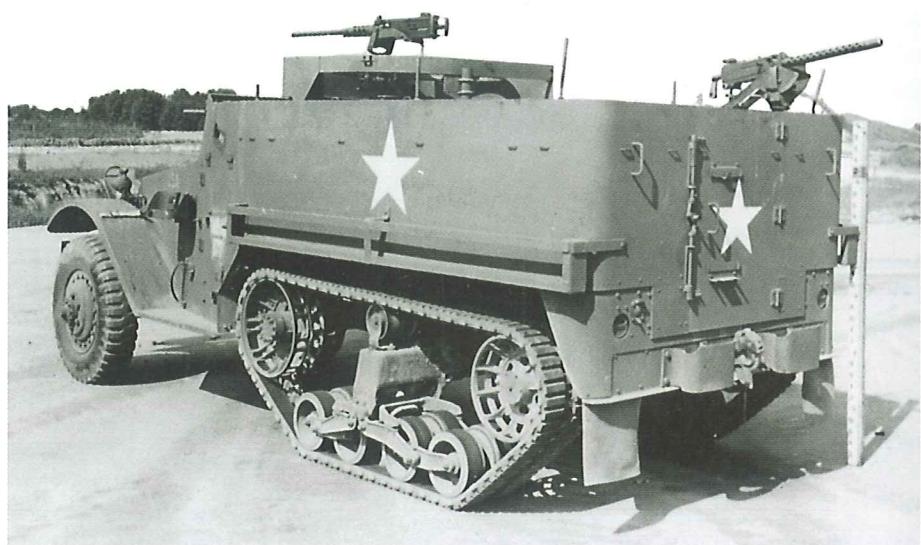


JANE'S TANKS OF WORLD WAR II

the M3 with a single .30cal, and the M4 with one .50cal and one .30cal MG plus an 81mm mortar with 126 rounds. In practice, armament varied widely. The M5 was a version of the M3 built by International Harvester using their engine, but was otherwise essentially identical. The M9 was the I-H version of the M2. The M21 mortar carrier was an M3 personnel carrier adapted to fit the 81mm mortar firing forward.

On all these models the machine guns were pintle-mounted on a rail that ran around the top of the rear compartment. In 1942 the rail was replaced by a ring mount over the co-driver's position and fixed pintles in the rear compartment. M2, M3, M5 and M9 vehicles so built or retrofitted were given the "A1" suffix.

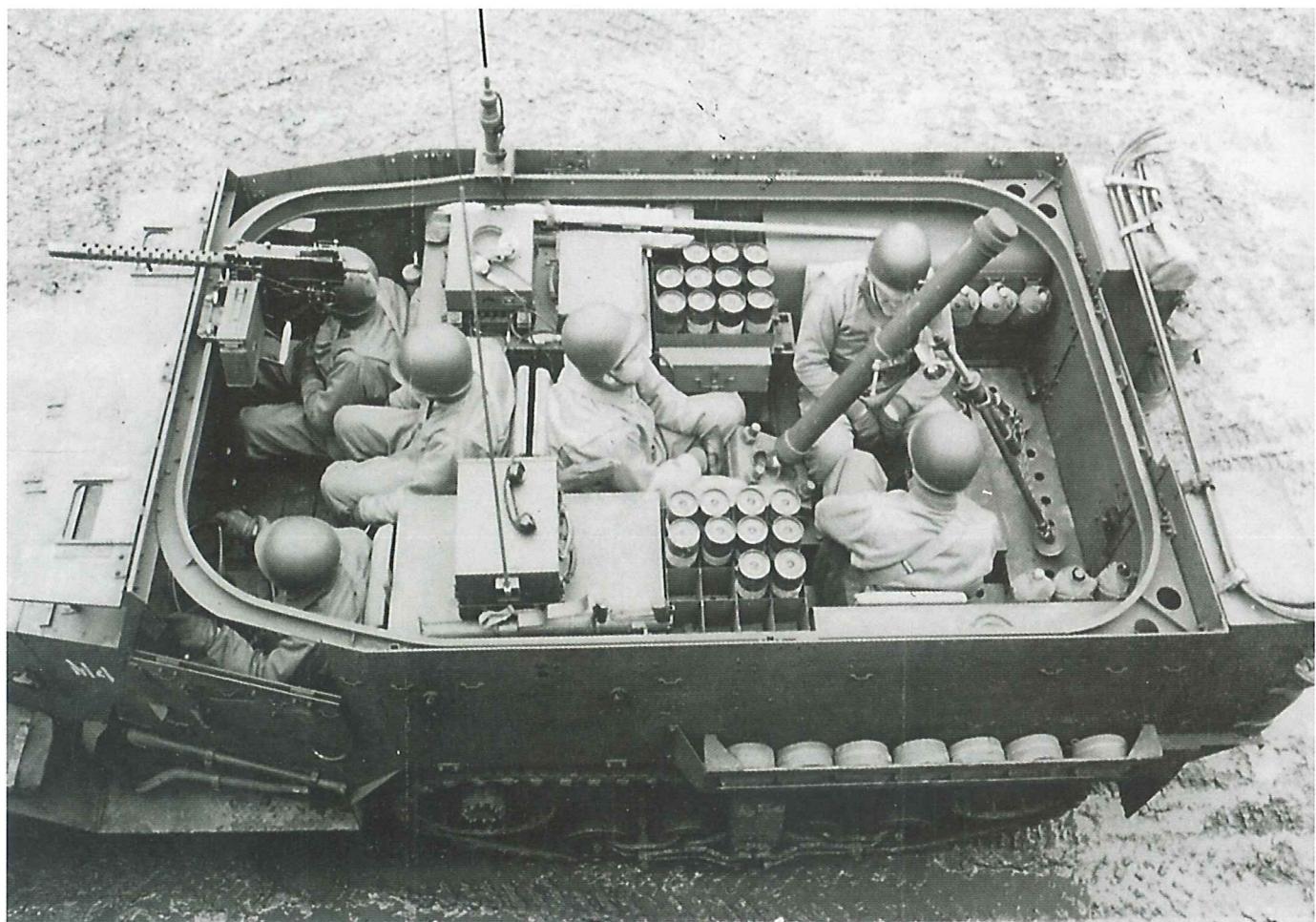
The M2 and M9 vehicles were used for reconnaissance and as prime movers for artillery, while the M3 and M5 were used as personnel carriers. In fact, there proved to be little advantage to the smaller M2/M9 family and they were gradually replaced by the roomier M3/M5 vehicles. All the vehicles had relatively



short track sections compared to the German half-tracks, but the use of a powered front axle partially compensated and their great reliability led to their use in a wide variety of roles.

Above: An M9A1 half-track personnel carrier

Below: Interior of an M4A1 mortar carrier, note the arc-shaped bipod receiver on the floor at the rear

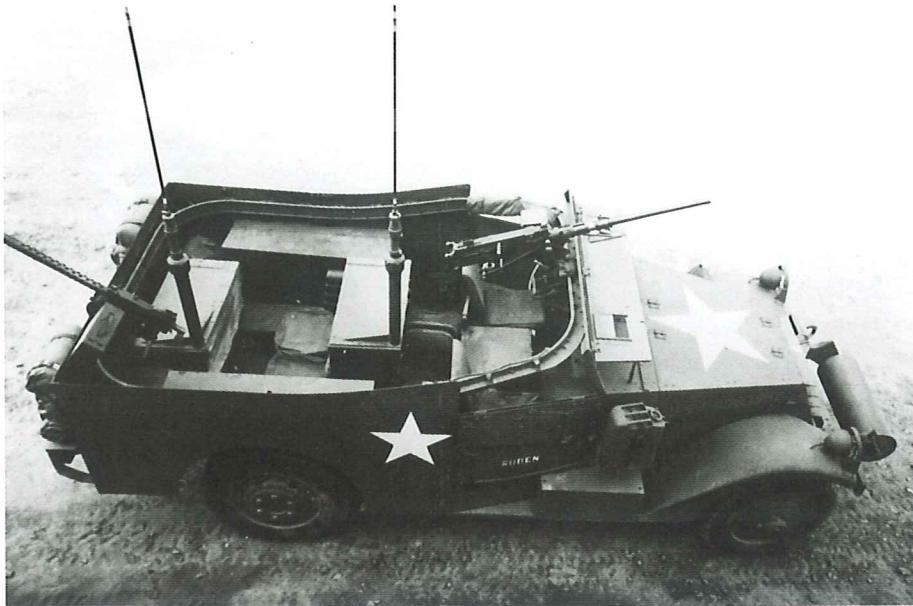




Scout Car M3A1

The M3A1 was built using a commercial-type 4x4 truck chassis surmounted by an armored body set on a channel-section frame. The driver and the commander sat in the front, while the personnel compartment in the rear could hold six troops. A skate rail encircled the top of the body interior, on which were mounted a .50cal MG and a .30cal MG. Armored shutters, controlled from the driver's position, protected the radiator, and a drop-down armored cover with direct-vision slots could protect the windshield. No overhead protection was provided except for a canvas cover. Designed for "high-speed scouting duty", the M3A1 was quickly found to be too large, too poorly protected and too weakly armed for that role. However, it quickly became a jack-of-all-trades and served a useful life as ambulance, repair vehicle, command vehicle, and any other tasks ingenious troops could think up.

M3A1 Scout Car



	Weight (tonnes)	5.6	Front Armor (mm)	12
	Length (m)	5.61	Side Armor (mm)	8
	Width (m)	2.03	Engine HP	87
	Height (m)	1.98	Road Speed (km/h)	84

Armored Car T-17E1

The 4x4 T-17 armored car was built with a monocoque hull, with no frame, the springs, steering gear, transfer case, etc., being attached directly to the hull. The main armament was a 37mm M6 gun and a .30cal M1919A4 machine gun in a combination mount in a power-operated turret. A second .30cal MG was mounted in the bow and a third on an AA mount on the turret roof. The T-17E2 was similar to the T-17E1 but was intended as an AA vehicle, with a Fraser-Nash power turret mounting two .50cal machine guns. The machine guns could be elevated from -10° to $+75^\circ$ and the turret traversed at 43° per second. Although built in quantity, the T-17E1 and E2 were never accepted for service in the US Army, all being handed out as aid, mostly to the British who called them the "Staghound".



	Weight (tonnes)	13.9	Front Armor (mm)	21
	Length (m)	5.49	Side Armor (mm)	19
	Width (m)	2.69	Engine HP	97
	Height (m)	2.31	Road Speed (km/h)	92

T-17E1 armored car



Armored Car M8

This 6x6 vehicle had a crew of four: a driver in the left front, assistant driver on the right, the gunner to the left of the main gun and the commander (doubling as loader) to the right. Since the assistant driver had no substantive duties (or controls) the radio was often moved near his location. The manually-operated cast steel turret mounted a 37mm M6 gun and a coaxial .30cal MG, and was open at the top except for a small portion over the gun and sight. Early models did not include a .50cal machine gun, but many units added a ring mount for such a weapon in the field and later production vehicles included a pintle-mount on the rear turret lip. The M8 was fast and maneuverable and was adequately armed for its time, although thinly armored. A turretless version, the M20 utility car, could carry five to seven crewmen for command and other duties.

Late production model M8

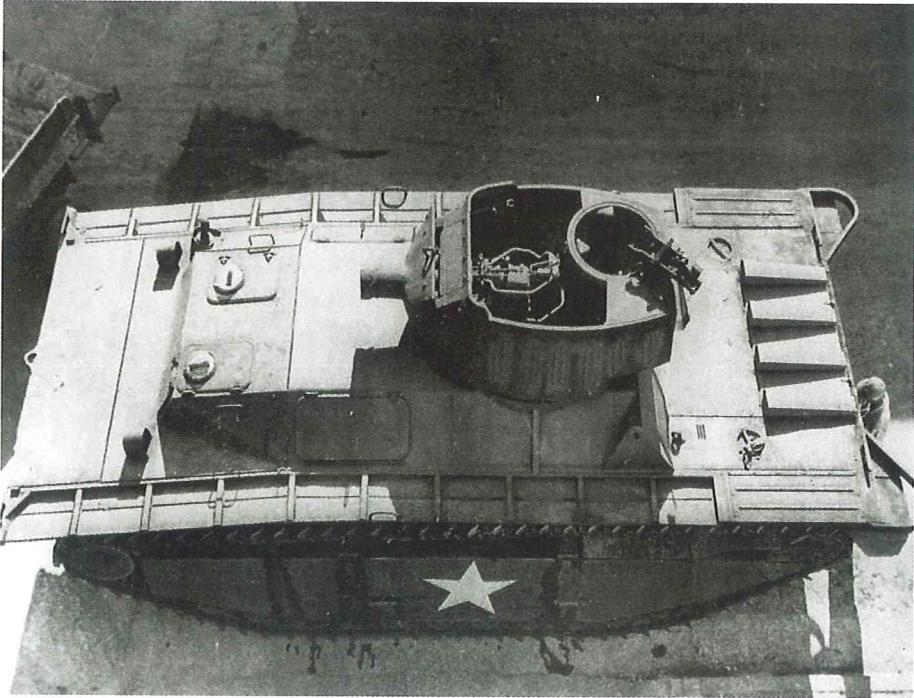


	Weight (tonnes)	7.9	Front Armor (mm)	19
	Length (m)	5.00	Side Armor (mm)	19
	Width (m)	2.54	Engine HP	110
	Height (m)	2.24	Road Speed (km/h)	92

Landing Vehicles Tracked

The LVT-1 was a large, open-topped unarmored tracked amphibian designed mainly for the supply role. The LVT-2 was an improved version that sought to remedy one of the LVT-1's main shortcomings, its short mechanical life. The new powertrain was taken from the M3A1 light tank and a new suspension gave longer life and a better ride on land. That still left one great shortcoming in the LVT configuration, that with the engine at the rear and the cargo hold in the center, cranes had to be used to load and unload cargo, and embarked troops had to jump over the tall sides to disembark. On late production models the cab was armored. The LVT-4 moved the engine forward, creating space at the rear for a powered ramp. Not only troops, but jeeps and small artillery could be loaded and unloaded without difficulty. Unfortunately, it did not become available in numbers until 1945.

Extremely useful for logistical duties, the LVTs, even when fitted with extemporized armor, suffered grievously when used in the assault role.



Above: An LVT(A)-4 with the 75mm Howitzer but without the Marianas Package



The LVT(A)-1 was similar to the LVT-2, but made of 6-12mm armor instead of mild steel, and fitted the turret of the M5A1 light tank (minus the bustle) on the roof, along with two scarf mounts for .30cal MGs. The LVT(A)-2 was an armored carrier version of the LVT(A)-1 with a cargo compartment replacing the armament stations. The LVT(A)-4 was similar to the LVT(A)-1 but used the turret of the M8 howitzer motor carriage with its 75mm howitzer. In order to accommodate the larger turret the scarf rings had to be suppressed, leaving it with no secondary armament except the exposed .50cal AA mount, which was to prove a serious shortcoming. The "Marianas model" of the LVT(A)-4 replaced the .50cal with two shielded .30cal MGs and added a third weapon in a ball mount at the front.

First column LVT(A)-1,

Second column LVT(A)-2,

Third column LVT(A)-4

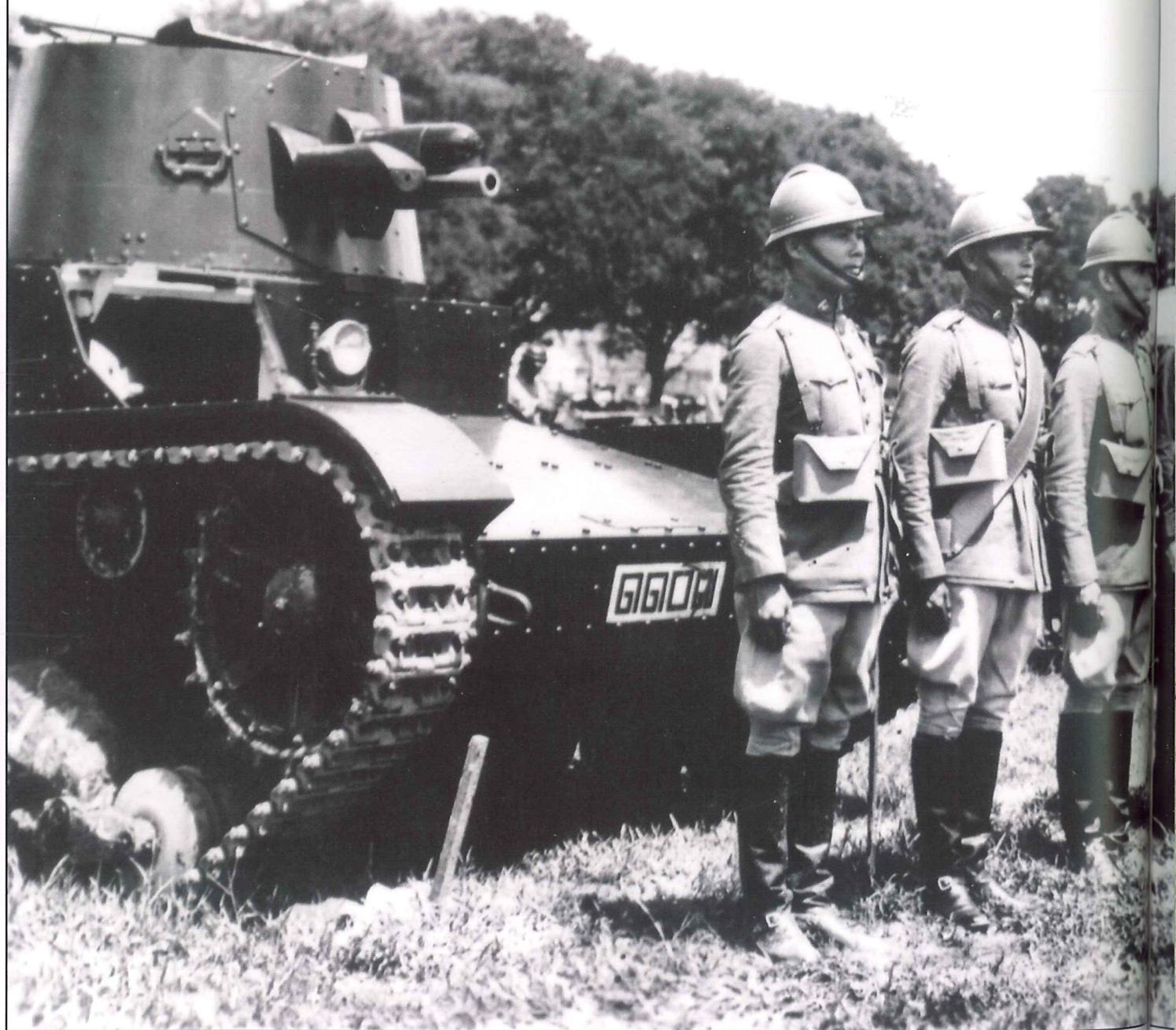
	14.8	14.4	18.0
Weight (tonnes)	14.8	14.4	18.0
Length (m)	7.95	7.95	7.95
Width (m)	3.25	3.25	3.25
Height (m)	3.07	2.46	3.07
Front Armor (mm)	13	13	13
Side Armor (mm)	6	6	6
Engine HP	250	250	250
Road/Water Speed (km/h)	40/10	40/10	40/10



Above: An LVT(A)-1 with its 37mm gun

Below: An LVT(A)-2 Armored Personnel/Cargo Carrier







Other Countries



Afghanistan

The weak central government of Afghanistan purchased few armored vehicles. A few Lancia IZ armored cars and four FT-17 light tanks comprised the armored strength until 1931. They bought six T-26 Model 1931 tanks and a small number of BA-3/6 armored cars from the Soviet Union, delivered in 1933-35. In 1935 another purchase was made, this time from the Henry Disston Company of the US, which provided eight Caterpillar 35 tractors with armored bodies and a turret with a short 37mm gun and a .30cal machine gun. An only slightly better vehicle was purchased in 1939, in the form of a dozen CV.35s from Italy. The only modern AFVs to be ordered were ten T-11 models (vz.35) from Skoda in 1939. These were completed in early 1940 and accepted by the Afghan purchasing commission in March, but were never delivered due to the war situation.

Argentina

A single Fiat 3000 Model 21 was delivered in the early 1920s, and although this remained in service for training duties until 1943, no further examples were purchased. In 1928 six machine gun-armed Vickers-Crossley 6x4 armored cars were purchased and these were distributed in two-car sections to the 2nd, 8th, and 10th Cavalry Regiments. The final acquisition came with the purchase of 12 Model 34 light tanks from Vickers, which were delivered in 1938 and were locally designated the Modelo 1938. Interest then turned to the Czech LTH series, but the outbreak of the war rendered that academic.

Argentina's pro-Axis tilt kept it out of the lend-lease program, so efforts were made to develop an indigenous tank. In 1942 the Dirección General de Fabricaciones Militares under Colonel Alfredo Aquiles Baisi was established and it immediately began work on a medium tank with a 75mm gun. By dint of a massive effort involving not only the DGFM workshops, but also 80 private firms, the first Nahuel DL-43 tank was presented on 4 June 1944. The overall layout was clearly inspired by the Sherman but was nonetheless a unique design. Making use of available



Left: A Disston tractor tank outside Kabul (PMK)

consideration was given to several other vehicles, including the Italian M11/39, but no full orders had been placed by the time of the Anschluss.

In addition to the Army vehicles, the Vienna police purchased three used PA-II armored cars from Czechoslovakia in 1933 and these remained in service until the German take-over. Later acquisitions comprised eight ADGZ for the Gendarmerie and six for the federal police.

All these vehicles fell into German hands after the take-over. The Italian vehicles appear to have been scrapped, while the ADGZ armored cars were handed over to the SS and security units. A further 25 such vehicles were ordered in 1942 to replace losses and expand the armored security forces.

Belgium

Renault FTs acquired in the early 1920s had been discarded by the mid-1930s, but parliament was extremely reluctant to sanction the purchase of replacement tanks, which they termed "offensive weapons". In early 1934 a contract was placed with Vickers for 38 of their commercial two-man light tanks, modified with tall conical turrets to mount the French 13.2mm heavy machine gun, followed by a second order for four more in 1935. All 42 were delivered in 1935 and were known as the T 15 light tank in local service.



Right: A Nahuel in a 1945 parade (PMK)

resources, it was powered by a Lorraine-Dietrich 12 EB aircraft engine that had been built in 1931-32 by FMA, uprated to 500 hp. The main armament was the 75mm L30 Krupp M1909, which the Argentine arsenals had in large quantity as the standard field gun. It had been planned to use the more powerful 75mm L40 Bofors gun, but too few were available. A unique feature of the tank was the triple M1927 machine gun mount in the bow. By the time full-scale production was begun, however, the war was over and large quantities of surplus tanks were available on the world market at low prices. Production of the Nahuel thus ceased after only 16 had been built.

Austria

The first Austrian Army AFVs were delivered in March 1934, four Lancia IZ armored cars, known locally as the M30, armed with two Schwarzlose MGs in the turret and one more in the hull rear. These were followed by Italian tankettes. The first 12 CV.33 were ordered in 1934 and delivered in February 1935. They differed from the Italian originals in their armament: a single Schwarzlose instead of twin Breda machine guns. Further batches in the next few years brought the quantity up to 60,

Right: An ADGZ armored car

At the same time, a contract was placed with the same firm for 200 tracked utility tractors and in 1936 another batch of 276 was ordered, this time in components for local assembly. Further vehicles were apparently built under license by the "Familleheureux works". The tractors were initially used to tow the 47mm FRC anti-tank gun, but 30 were built as SP guns by mounting the gun in a shield with limited traverse oriented to the rear of the vehicle. These vehicles, the T 13 Mod 1, were followed by a second series of 21 similar vehicles converted from tractors as the T 13 Mod 2. The main series of 150 vehicles, known as the T 13 Mod 3, featured a gun mounting with all-around traverse and a revised suspension. Although powerfully armed for the time, the thin armor (6-13mm) and open-backed gun shield made them suitable only for defense.

The only true tanks were ACG models purchased from France and armed with the FRC 47mm gun and a Hotchkiss 13.2mm MG. Twenty-five were ordered, but production difficulties delayed delivery and only 12 actually arrived. These vehicles had sat in storage until a squadron was formed to man them in September 1939, and as a result only eight could be made serviceable.

Each of the six cavalry regiments was to be allocated six T 15s and six T 13 Mod 3, although two of the regiments only had four light tanks. Each of the 12 regular and first-reserve infantry divisions included an AT company with 12 T 13 Mod 3. In addition, the three bicycle Chasseur Ardennais regiments each included three T 15s and 16 T 13s.

Bolivia

In 1932 Bolivia purchased two Mk VI machine gun carriers and three Medium E (6-ton) tanks from Vickers, the latter consisting of one twin-turret model and two single-turret models. All were lost in 1933 in the Chaco War, with Paraguay capturing two of the Mediums. The rearmament between the 1935 ceasefire and the 1938 peace treaty saw the purchase of 29

Right: Two T 15 light tanks and a T 13 Mod 3 SP gun before the war



CV3/33 tankettes, but only 14 had arrived by the time Italy joined the war, when further deliveries proved impossible. Those 14 were grouped into a small mechanized detachment of 100 men, forming the only armored unit until after 1945.

Brazil

In 1921 twelve Renault FTs were purchased, seven with MGs, four with cannon and one radio tank. Worn out by 1939, they were retired to school duties that year. The replacement was to be the Italian CV-33. The organization tables required 22 vehicles and 23 or 24 appear to have been purchased: 17 with twin 7mm Madsen light machine guns (the standard light MG of the Brazilian Army), 3 with 13.2mm Breda heavy MGs and three radio tanks.

By January 1941 the General Staff was drawing plans for an armored division, although

no source of vehicles was immediately apparent. This changed with the advent of the US Lend-Lease program in March 1941. By September they had filed requisitions for 19 M3A1 scout cars, 65 M3 light tanks and 28 M3 medium tanks, along with 16 more scout cars for a motorized division. These requirements naturally increased considerably as time went on.

An initial 10 scout cars and 10 M3 light tanks were purchased for cash in 1941 and quickly delivered.

Lend-Lease deliveries started in 1942. A total of 74 M3A1 scout cars were received, 36 in 1942, 35 in 1943 and 3 in 1945. A total of 417 M3-series light tank were delivered under LL. No detailed breakdown is available, but by October 1943 receipts totalled 130 M3 and 160 M3A1. The main medium tank was the M3





Left: The Bolivian twin-turret medium E tank (PMK)

Central American & Caribbean Republics

None of these nations had armored vehicles before the start of the war. On the outbreak of the war the US began planning for modest programs to strengthen the forces in this area. Lacking a developed industrial infrastructure, these nations could not absorb armored vehicles in large numbers or of sophisticated design. The program thus resulted in the provision of nominal quantities of obsolescent vehicles. These comprised 19 M3A1 scout cars, 30 M3A1 light tanks and 14 Marmon-Herrington CTMS tanks, the latter being commercial products the US had been stuck with after the fall of the Netherlands East Indies.

The largest force was in the Cuban Army, two tank companies each of 10 (nominally 17) light tanks and one scout car. The other nations formed small armored detachments with their vehicles.

series; 80 (mostly M3A3s) were delivered in 1942, followed by 24 more in 1943. One battalion set of 53 M4 Shermans was shipped between mid-1944 and early 1945. Armored cars comprised 20 M8s and 54 T-17s, all delivered in 1944. Deliveries of half-tracks were 20 M5s delivered in mid-1943 and 8 M2A1s and 3 M3s delivered in 1944.

The Brazilian Expeditionary Force deployed to Italy was infantry, so the only armor they took with them were 13 M8 armored cars and five half-tracks.

Bulgaria

The first acquisition of AFVs came with a 1934 contract to Ansaldo for 14 CV33 tankettes and an equal number of heavy trucks to transport them. These were delivered in 1935 and used to form the 1st Tank Company. In September 1936 a second contract was signed, this time with Vickers for eight single-turret 6-ton tanks with 47mm guns and mounts for locally-provided MGs. Delivered in 1938, these formed the 2nd Tank Company, allowing the formation of the 1st Tank Battalion. In February 1940 Germany sold 26 used LT-35 light tanks with delivery a few months later, followed by ten similar (but new-build) T-11 models in August–October 1940. These were used to form 3rd Tank Company and fill out the tank battalion.

In May 1941 Germany delivered 40 ex-

French Renault 35 tanks to form the 2nd Tank Battalion, and the two battalions were grouped into an armored regiment. Tactical employment of the unit was made difficult by the fact that few of the vehicles had radios: none of the CV33s or Vickers tanks, only one Renault, and only the platoon/company commander T-11 tanks.

In early 1943 Germany agreed to the "Barbara" program, under which they were to supply 25 PzKw I (for training), 10 PzKw III, 91 PzKw I, 55 StuG 40 and 20 SdKfz 222/223 armored cars. No PzKw I tanks remained in the inventory, so the Germans substituted 19 captured H-39 tanks over Bulgarian objections. Deliveries under the Barbara program started in April 1943 and ran through February 1944, and actually totalled 10 LT-38, 97 PzKw IVJ, 55 StuG40G, and 13 SdKfz 222 and 7 SdKfz 223 armored cars. This permitted the reorganization of the tank force into two mixed (PzKw IV/T-11) battalions and the R-35 battalion in 1943, with the older tanks being relegated to security duties.

By 1944 the force had expanded to an armored brigade. Ironically, its only combat action was against the Germans, in Serbia and Kosovo in the autumn of 1944.

The Hotchkiss tanks, along with an additional six S-35s, were handed over to the police. The Soviets delivered no armored vehicles after Bulgaria switched sides.

1942 1943 1944 1945

M3A1 Scout Cars

Costa Rica	-	2	-	-
Cuba	-	2	2	-
Dominican Republic	-	1	3	-
Guatemala	-	4	-	-
Haiti	-	2	-	-
Honduras	3	-	-	-

M3-series Light Tanks

Cuba	-	12	-	-
El Salvador	-	6	-	-
Guatemala	-	6	-	-
Haiti	-	3	-	-
Nicaragua	-	3	-	-

Marmon-Herrington CTMS Tanks

Cuba	4	4	-	-
Guatemala	-	6	-	-

US Shipments to Central America/Caribbean

Chile

The only armored vehicles acquired before the war were five Carden-Loyd Mk VIb machine gun carriers used for demonstration purposes. The US delivered an initial 25 M3A1 scout cars in 1942. The major shipments came in late 1943, comprising 30 M3A1 light tanks, 18 more scout cars and 10 M5 half-tracks. The



final batch of 7 scout cars was delivered in January 1944. These permitted the creation of two mechanized battalions.

China

Small quantities of FT-17 tanks and improvised armored cars were used by various warlords, and the central government purchased their first models from France in August 1929 (20 tanks) and December 1931 (10 tanks). The first purchase of new armored vehicles by the central government came in 1930, when 12 Mk VI machine gun carriers with trailers were ordered from Vickers. This was the first of several contracts with that firm, for in January 1933 the Cantonese provincial government ordered 12 amphibian light tanks, while in late 1933 the central government ordered a single example. In early 1934 the central government ordered 12 more amphibian light tanks and 12 6-ton tanks (single turret, no radio), and a few months later four more amphibians and four more single-turret 6-tonners. Finally, in September 1935 they purchased four more single-turret 6-ton tanks and four light tanks, this time all with radios. The last of these tanks was delivered in October 1936.

China next turned to Germany, which had a strong military advisory mission in the country, and arch-rival France. In December 1934 they placed an order for 36 as-yet-undesigned armored cars with Germany, these being delivered as 18 MG-armed SdKfz 221 and 12 2cm-armed SdKfz 222 in 1936-37. In mid-1935 a second order was placed for 15 PzKw IA light tanks and 18 more armored cars. Germany had few armored vehicles to spare, however, and the last batch, 14 armored cars, arrived in Canton in December 1937.

In France they placed an order in March 1936 for 10 Renault UE chenillettes (fitted with a small superstructure and armed with a light machine gun) and 12 AMR-ZB tankettes. A further four AMR-ZB were ordered a few months later by the Yunan Provincial Government. Half of the ZBs were armed with the short 37mm SA-18 gun and the other half with 13.2mm MGs. The Yunan ZBs were delivered in October 1938. Those for the central government were delivered to Haiphong for transhipment in 1938 but held up there due to Japanese pressure. The UEs appear to

have been confiscated by the Indochina colonial government but the ZBs seem to have been released for delivery via Rangoon in February 1940 (two vehicles) and June 1940 (eight vehicles). The fate of the remaining ZBs is unclear.

The Japanese invasion of China in 1937 provided the impetus for further acquisition of vehicles. A likely source was the Soviet Union and in 1937 the Red Army was invited to re-establish the military mission expelled 10 years earlier. They immediately set about organizing the 200th Mechanized Division with about a 100 FAI and BA-6 armored cars driven overland via Mongolia and T-26 Model 1933 tanks brought by sea. The first 50 tanks arrived at Canton in March 1938 and another 32 at Yunnan about a month later. The division, with a steadily declining tank complement, remained in service until the end of the war, performing well in Burma in 1942.

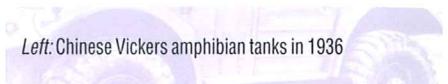
Finally, in apparent desperation, they purchased 101 L3/35 tankettes from Italy, half armed with Czech machine guns and the other half with Belgian, delivered in January-February 1938. Based initially at Changsha, these vehicles

apparently saw little use.

By 1940 the only remaining source for armored vehicles was the US, and in January 1941 China was approved for Lend-Lease. US and British requirements had priority, however, and the only immediate result was approval for the transfer of 36 M3A1 scout cars (delivered in October 1941) and a contract with Marmon-Herring in May 1941 for the production of 240 of their CTLS two-man tanks. The Chinese specified a turret armed with a .50cal machine gun and capable of accepting 20mm guns that the Chinese had on-hand. Apparently, this was not conveyed to the manufacturer, for when the first one came off the production line in March 1942 it had the standard little .30cal turret. The Chinese refused to accept the tanks, and the US agreed to substitute 1,200 Universal Carriers. In fact, the total number of carriers supplied was 1,500 (1,100 MG and 400 3" mortar), all from Australian production in 1942/43. These were used for the most part to form the carrier platoons of the British-pattern infantry battalions being formed in India and Burma.



Right: The Renault AMR-ZB combined a modified AMR with the R-35 tank suspension. Here a Chinese vehicle with 13.2mm armament in Burma, 1942 (George Rodger/Timepix)


 Left: Chinese Vickers amphibian tanks in 1936


In June 1943 the US assigned 1,000 M3A3 light tanks to China, but only 536 were actually shipped from the US, and only 100 of those actually made it to Chinese forces in Burma. In their place the British, reluctantly, provided 116 Shermans in late 1944 for three battalions for use in Burma.

Colombia

The Colombian Army had no motorized forces until the start of the Lend-Lease program. Equipment for a small tank company, with twelve M3A1 light tanks and two M3A1 scout cars, was assigned in early 1943. The tanks arrived in mid-year and the scout cars in January 1944.

Croatia

The independent state of Croatia was declared on 10 April 1941, followed the next day by the official formation of the Domobranstvo, or armed forces. Shortly thereafter the Ustasha party formed the "Ustasha Vojnica", an analogue of the German Waffen SS. The bulk of the armor was concentrated in the guard battalion of the UV. The local German regional command furnished a wide variety of captured armored vehicles to Croatian forces, starting with 18 ex-Polish TKS tankettes. In addition, ex-Yugoslav R-35s were used. With the Italian surrender in September 1943 the Croatians seized numbers of AFVs, including about 26 L 6/40 light tanks and Semoventi 47 variants. Germany also apparently

handed over a small number of PzKw IV tanks and Italian Semoventi 75s.

Denmark

Other than a few extemporized armored trucks, Denmark's first armored vehicles were purchased in August 1933 – two Carden-Loyd Patrol Tanks Mk VI. They were delivered without armament and fitted with a single light machine gun each, but proved unsatisfactory, with limited reliability and a tendency to shed tracks. They were discarded in 1937. Attention then turned to armored cars and in 1934 a single Landsverk L-185 armored car was purchased for DK 60,000. Built on a Fordson 4x4 chassis, it proved underpowered and overloaded and by 1939 had been relegated to training duties. In May 1935 a second contract was placed with Landsverk, this time for two of the more modern L-180 models at DK 100,000 each. These vehicles, built on Büssing-NAG 6x4 chassis, proved more successful.

By 1937 the army force structure plan called for two armored car squadrons (each with nine armored cars), one in each of the two cavalry regiments. The Landsverk Lynx was selected and an initial contract for three vehicles, at DK 125,000 each, was signed in December 1938. These vehicles were delivered in April 1939. A second contract, for nine more vehicles, was signed in May 1939 and a third for the final six in February 1940. These last two batches, however, had not been delivered by the time of

the German occupation. The three Lynxes in service saw no combat in 1940 and remained on Danish Army strength until the army was dissolved in 1943, when they were taken over by the Germans for occupation duties.

Ecuador

The Army had no armored vehicles until 1942. Ecuador's declaration of war on the Axis immediately after Pearl Harbor brought a US Army mission and Lend-Lease Equipment. In 1942 twelve Marmon-Herrington CTMS tanks and eight M3A1 scout cars were delivered to form an armored squadron with a four-vehicle scout car platoon and two five-vehicle tank platoons. In 1943 42 M3A1 light tanks and four more scout cars were assigned by Lend-Lease, these arriving between mid-1943 and mid-1944.

Eire

Britain handed over thirteen Rolls Royce armored cars to the Irish Republic in 1921, and these served through the end of WW2. In 1935 the army ordered six L-180 armored cars and four separate turrets from Landsverk. The turrets were locally fitted to armored bodies mounted on Leyland 6x4 truck chassis. Cut off from foreign supplies during the early part of the war the Irish improvised. They commissioned Thompson & Co. of Carlow to produce 28 steel hulls for Ford chassis. Built during 1940/41 these three-man vehicles were armed with a single light machine gun and constructed of mild steel, proof against .303 ball ammunition, but not against AP ammunition. A further three were fitted to slightly larger Dodge chassis. In 1943 17 Beaverette Mk III and IV were supplied by the UK. The armored cars were used to form the 1st – 3rd Armoured Squadrons, while the Beaverettes were used by the 4th Armoured Squadron. A squadron's worth of Universal MG Carriers was also received, but that squadron was broken up in early 1943 and the vehicles distributed to the infantry battalions.

Estonia

By 1939 Estonia still had nine old armored trucks from the fighting in 1919. Five of these



Right: A locally built Irish Leyland armored car (PMK)

were built on three-ton AEG chassis and the other four were captured Russian vehicles (three Putilov-Austins and a Putilov-Garford). All were 4x2 drive vehicles and completely obsolete. Also on strength were twelve Renault FT tanks (3 with 37mm gun, nine with machine gun) purchased in 1920. Later acquisitions consisted of 13 armored cars built on Crossley 4x2 chassis (four with 37mm gun for the home guard and nine with machine guns for the Army) delivered in 1927-28, and six Polish TKS tankettes purchased in 1934. At the time of the Soviet occupation the armored force consisted of the 1st Armored Company with nine old armored trucks, the 2nd Armored Company with three FTs and nine Crossleys, and the 3rd Armored Company with nine FTs and six TKS.

Finland

Finland's first official procurement of armored vehicles came in 1919 with the purchase of 32 FT tanks (14 with 37mm and 18 with 8mm MG) from Renault. Another two were delivered in 1921. In 1933 three vehicles were purchased from Vickers for trials: a Mk VI* MG carrier, a 6-ton tank and a Model 1933 light tank.

The results were considered satisfactory for the 6-ton, but not the other two, and in mid-1936 a contract was placed for 32



vehicles. All the Vickers tanks were single turret models, delivered without armament or optics. The first 12 were delivered in 1938 and the remainder in 1939. The Vickers were armed locally with 37mm psvk36 guns, although not all were ready in time for the Winter War of 1939/40.

Although five of the Vickers tanks and most of the FTs were lost during the Winter War, a considerable number of Soviet tanks were captured and put into service. By May 1941 the army included 40 T-26s (including 10 twin-turret M1931 and six flame tanks) and 29 T-37A and 13 T-38 amphibian tanks.

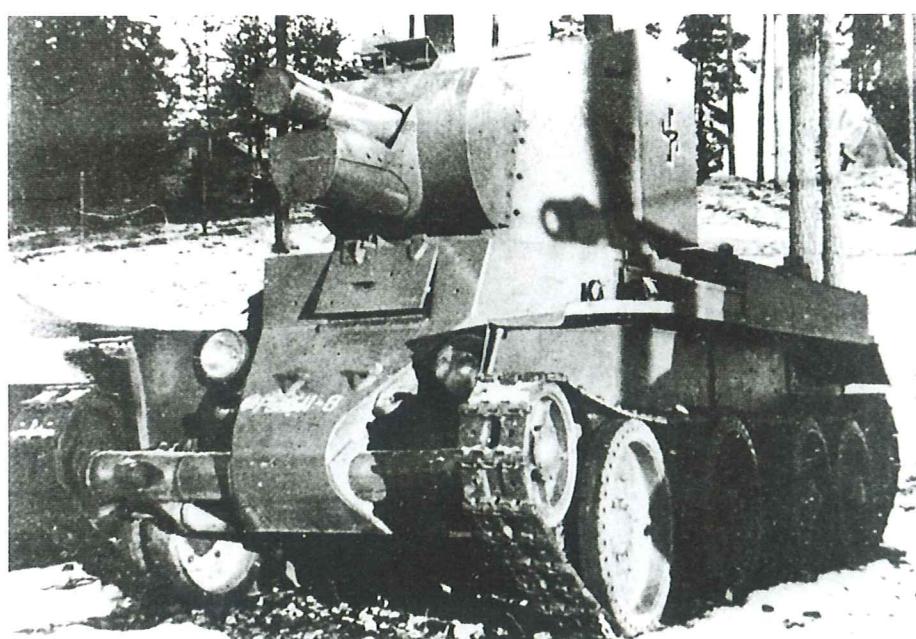
After the Winter War the British 6-ton

tanks (which had been the design basis of the T-26) were refitted with Soviet 45mm tanks and called T-26E. Similarly the twin-turret and flame-thrower T-26s were modified into normal single-turret models with the 45mm gun. Some also received a ball-mounted MG in the hull front and a fourth crew member to man it.

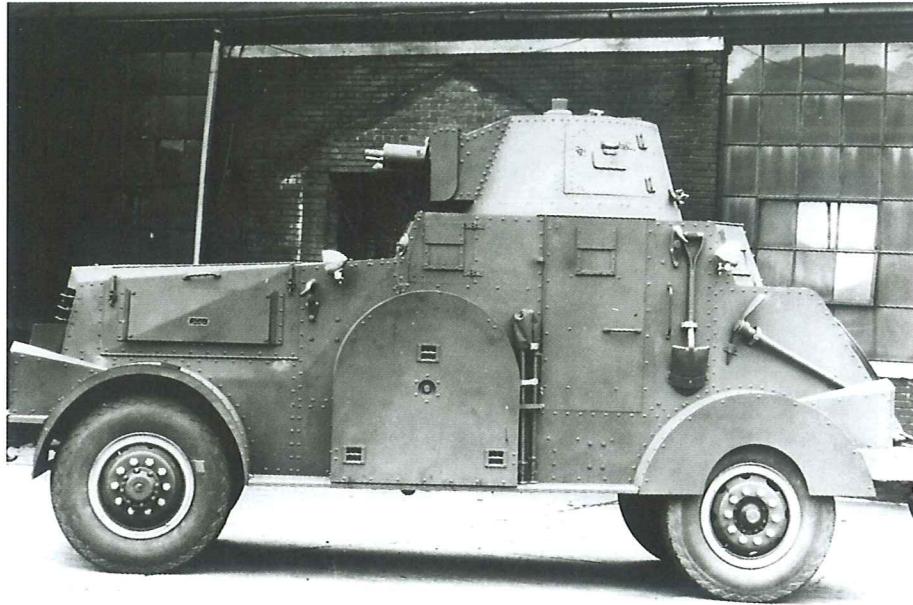
Further captures during 1941-42 added more Soviet tanks to the Finnish park. By mid-1942 they had 127 T-26s (including 6 flame tanks and 24 T-26E), 33 light amphibian tanks, 53 BT-7M fast tanks (not all operational), 3 T-34/76s, 7 T-28s and a single KV. The number of T-26s remained fairly constant for the rest of the war, forming the bulk of the Finnish armored force. Fourteen more T-34s (including 9 T-34/85s) were added in 1944.

An interesting conversion was undertaken starting in late 1942, modifying 18 of the BT-7s into assault guns. This was done by welding a big box extension to the rear of the turret and rearming it with the British 4.5" howitzer. Although used in combat, the resultant vehicle, known as the BT-42, was not considered successful, as it was cramped, firing was slow due to the separate-loading ammunition, and aiming difficult.

As a replacement for the BT-42s an order was placed in mid-1943 for 45 StuG40 Model G assault guns. Only 30 of these



Left: The Finnish BT-42 was a generally unsuccessful attempt to create a fire support version of the BT light tank



Left: A Marmon-Herrington Armored Car built for Iran. Not to be confused with the South African vehicles also so-named because they used the Marmon-Herrington 4x4 conversion kits

Iran (Persia)

The Shah launched his motorization program in 1933. At that time the Army possessed four old Rolls Royce armored cars, still with solid tires, and two FT tanks. In July 1933 the Army placed a contract with American-LaFrance to build an armored car to a general Iranian design. The effort failed and the vehicle was rejected. A similar contract was awarded the next year to Marmon-Herrington. This vehicle placed a thinly-armored body on the chassis of a 4x4 M-H truck, surmounted by a Bofors turret with 37mm gun and coaxial MG. The armor was sufficient to protect against rifle-caliber ball ammunition, but not AP. This vehicle was accepted and a further eleven ordered as the Model TH 310 ALF, delivered in 1935.

The much larger portion of the re-equipment program was launched in January 1935 when tenders went out to several tank manufacturers and in May a contract was awarded to CKD for 30 AH-IV tankettes and 26 TNH light tanks. In September the award was increased to 50 of each, with the TNHs to be armed with 3.7cm A4 guns. Deliveries to Tehran occurred between August 1936 and May 1937. A few of the armored cars saw action against the British (and promptly surrendered) in 1941, but the rest of the

Greece

The Greek Army purchased trials batches of several vehicles in the early 1930s, including one Renault NC and two Vickers 6-ton tanks, plus two Carden-Loyd Mk VI carriers with trailers, but these had all been scrapped by the time the war broke out. During the war with Italy they did capture about 50 L3 tankettes, of which 27 were used to form the 19th Mechanized Division in January 1941. The British promised to provide Universal Carriers and Mk VIB light tanks, but by the time the Germans had launched their invasion only about 100 carriers had been delivered. The bulk of these were also issued to the mechanized division.



Right: An Iranian AH-IV tankette



Right: An Iraqi Crossley armored car (PMK)

armored force remained intact.

With the outbreak of the war these were to be the last armored vehicles acquired by the Iranian Army, although a few M3A1 scout cars were supplied to the Gendarmerie in 1943 by the US.

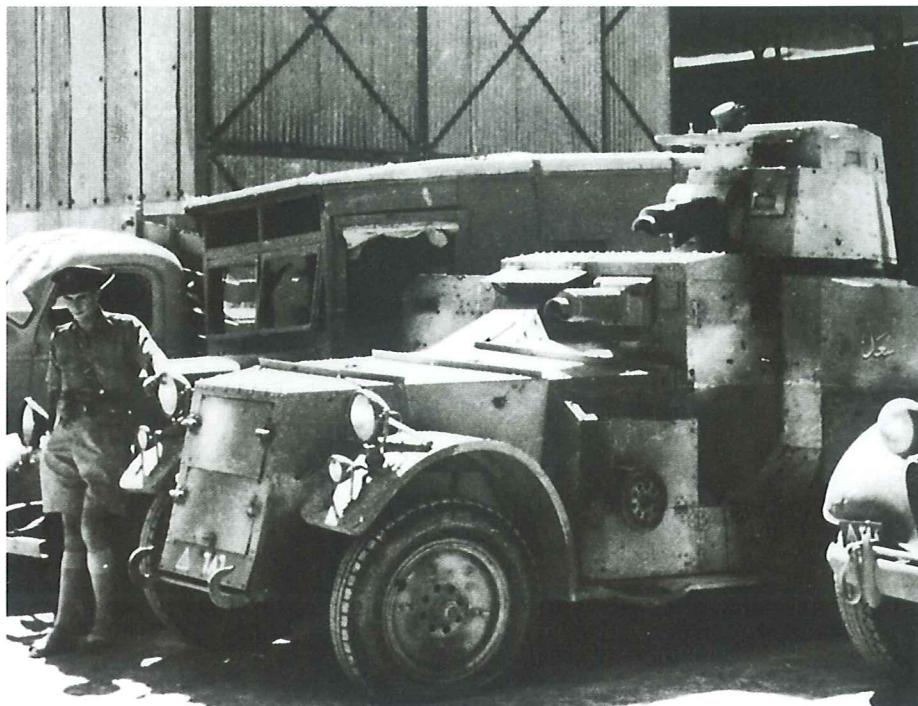
Iraq

A modest mechanization effort was begun in the mid-1930s that resulted in the 1937 delivery of ten armored bodies from Britain to convert Crossley 6x4 trucks into armored cars, and 14 CV.35 tankettes from Italy. After repairing some extensive water damage suffered during shipment the tankettes were placed in service in a new light tank company. That company, together with a motorized infantry battalion, formed the Mechanized Force. The tankette company took part in the 1941 campaign, losing several vehicles.

In 1942 the British began rebuilding the Iraqi Army, including the supply of 40 Chevrolet TG.130 armored cars to form an armored car regiment. Thus, by the time Iraq declared war on the Axis in January 1943 the Mechanized Force consisted of an armored car regiment (35 TG.130 in three squadrons), an armored car detachment (the surviving 10 old Crossleys, of which 6 were operational), the tank detachment (the surviving eight CV.35s), a motorized infantry battalion and an artillery battery. In late 1943 the tankettes were finally retired to training duties and replaced by three Crusader cruisers and six Mk VI light tanks donated by Britain. In early 1945 the British transferred 20 Valentine V and 26 Humber I, II & III armored cars from their local holdings to the Iraqi Army.

Latvia

On independence in 1920 Latvia inherited five used British tanks, three Mk V Composite and two Medium Mk B, and eight assorted armored cars. The first purchase of new-build tanks came in March of 1926 when six Fiat 3000A tanks (copies of the FT-17) were bought from Italy. Two of these were gun-armed with 37mm Puteaux and the other



four MG-armed with .303 Vickers weapons. In March 1935 18 light tanks were bought from Vickers, twelve of them M1936 models with .303 Vickers MG, the other six being M1937 models with a 2pdr. In May 1937 a contract was signed with CKD for 21 LTL tanks, although this was changed to the LTH model in March 1939. The tanks were to have been delivered between July and August 1940, but by that time the Soviets had already occupied the country. Thus, at the outbreak of the war in September 1939 Latvia's armored force comprised one armored car company (with six remaining old WWI vehicles), one company of old tanks (six Fiat 3000, two Composite and one Medium B), and two new tank companies (each nine Vickers). These were taken over by the Soviets in 1940.

Lithuania

The first purchase of armored vehicles came in 1923 when 12 Renault FT-17s were ordered from France. They arrived unarmed and were each fitted with a 7.92mm Maxim MG locally. A more modern design was clearly needed and in December 1933 the Army ordered 16 M1933 light tanks from Vickers, each armed with a single 7.92mm Vickers MG. A 1935 competition between Vickers, Landsverk and CKD was won by

Vickers and in May 1936 a further 16 tanks were bought, these being the similar M1936 model.

To this point all Lithuanian tanks were armed solely with machine guns and funds were set aside in the 1937-40 defense plan for the purchase of cannon-armed tanks to replace the now aged Renaults. Landsverk proposed its L-100 and L-120 models, while CKD returned with its LTL model. In May 1937 CKD was awarded a contract for 21 LTL tanks armed with 20mm Oerlikon guns. Numerous teething problems and design changes, however, delayed the roll-out of the first vehicle until mid-April of 1940. By this time Lithuania, like the other Baltic states, had been annexed by the Soviet Union and the tanks were never delivered.

Lithuania has the distinction of being the first nation to order the Landsverk 180-series of armored cars. Six L-181s on Daimler-Benz chassis were ordered in 1933 and delivered in 1934. Each of these vehicles was armed with a 20mm Oerlikon BW autocannon and two 7.92mm Maxim machine guns.

At the start of World War Two the Lithuanian armored force consisted of an armored car company with the six L-181s, one tank company with the 12 FT-17s, one company with the 16 Vickers M1933, and one company with the 16 Vickers M1936. All the vehicles were absorbed into the Red Army in March 1940.



Left: The prototype of the Dutch M39 armored car

At the time of the German invasion the order of battle showed only two armored units: the 1st Armored Car Squadron with 12 M36s, and the 2nd Armored Car Squadron with 12 M38s. A separate detachment of the Horse Artillery Regiment, known as the 'Yellow Riders' manned the Carden-Loyds. The M39s were in the cavalry depot awaiting finishing, and some of these were fielded on an extemporized basis.

Netherlands East Indies

Although much of the archipelago was unsuitable for armored vehicles, the KNIL (East Indies Army) actually purchased more of these than the home army. Improvised armored trucks known as Overvalwagen were built for local defense in the 1930s. The first major order for tanks was placed in 1937, covering 73 commercial light tanks from Vickers, two-man MG-armed vehicles analogous to the British Mk III light tank, along with two amphibious light tanks. At the same time a dozen Alvis-Straussler AC3D armored cars were ordered and delivered in 1939. In June 1939 another order was placed with Vickers, this time for 45 of the larger Command Tanks with 40mm guns, and a few months later a third order followed, this time for 80 utility tractors. In the event, when war broke out in Europe the British government

Manchukuo

The puppet forces set up by the Japanese in Manchuria had no armored vehicles until the late 1930s, when eight Isuzu trucks were given armored bodies by the Dowa Automobile Company. In 1943 about ten Type 94 tankettes were donated by the Japanese to form an armored company.

Mexico

Six Marmon-Herrington CTL (two-man) tankettes were purchased in 1937 and used to form the (sole) tank company. Lend-lease deliveries of armored vehicles began in late 1942 with the arrival of four Marmon-Herrington CTMS (three-man) tanks and three M2 half-tracks, followed by six M3A1 scout cars the following year. The US authorized 24 M3 (gasoline) light tanks in 1943, and these were delivered in 1944.

Netherlands

Committed to a purely defensive role in a small country, the Dutch Army saw little for armored vehicles. Two FT-17s had been acquired, mainly for testing, and fitted with M08/15 (Schwarzlose) machine guns. The only other tracked armored vehicles on strength were five Carden-Loyd Mk VI machine gun carriers.

The Dutch were slightly more active in their acquisition of armored cars. They ordered 12 L-

181s from Landsverk in 1935, these being armed with a 37mm Bofors anti-tank gun and three 7.92mm Lewis machine guns. They were known as M36 in Dutch service. This was followed by an order for 12 L-180 with the same armament, plus two command versions with a dummy main gun. The second batch vehicles were designated M38s by the Dutch.

Included in the second Landsverk order was also the purchase of 12 L-180 turrets. These were to be mounted on an indigenous design, the DAF PT3, officially designated the M39. The vehicles were completed by the start of the war, but the fitting of armament had not been completed and no radios installed.



Right: An Overvalwagen armored truck of the Dutch East Indies



Right: Berliet armored cars of the Portuguese GNR in 1942

confiscated all undelivered tanks after only 24 of the light tanks made it to the East Indies.

Forced to find another supplier, and alarmed by the success of German tank forces, the KNIL turned to the US. Orders were placed with Marmon-Herrington for 200 CTLS (two-man, MG-armed) and 120 CTMS (three-man, 37mm-armed) tanks in October 1940. A further 34 CTLS and 74 CTMS were ordered in March/April 1941, along with 200 MTLS (four-man, 37mm-armed) tanks. Of these, however, only a very few of the CTLS models had been delivered prior to the Japanese invasion. The weapons were contracted for separately, and it is unclear if the arms arrived with the tanks. Due to delays in the gun-armed tanks, 50 M3 light tanks were ordered, but these also never arrived.

Also ordered were 40 White Scout Cars from the US and 49 used and well-worn Marmon-Herrington Mk III armored cars from British Middle-East stocks, all of which had been delivered before the Japanese invasion.

Because few of these vehicles had been fully incorporated into the KNIL at the time of the invasion, the mechanized forces consisted of four cavalry platoons (with the Alvis-Strausslers) and the tank battalion (with Vickers light tanks), both at Bandoeng. The improvised armored trucks were scattered about the outlying islands guarding ports and airfields. The tank battalion launched a counterattack on 2 March 1941 against Japanese occupying Soebang and were initially successful, but infantry support withered and the unit was forced to retreat. The next two days saw the destruction of the battalion. Apparently few of the vehicles were seriously damaged, as the Japanese reported at the end of the war that they held 44 ex-Dutch tanks and 188 ex-Dutch armored cars on Java.

Paraguay

The Paraguayan Army captured two of Bolivia's three Vickers six-ton tanks (one twin-turret, one single-turret) during the Chaco War in 1933. These appear to have been sold to an international arms dealer and no additional armored vehicles were acquired until after World War Two.



Peru

An early convert to modern theories of mechanization, the Peruvian Army followed up on its 1930 purchase of six Carden-Loyd Mk VI MG carriers and trailers by devoting quite a bit of its 1937 budget to purchase 24 LTL tanks from CKD. The tanks were delivered in February 1939, when they were given the local designation Tanque 38/39. A 363-man tank battalion with two 12-tank companies was immediately established. The tanks proved popular in service, but further quantities could not be obtained. Lend-Lease was the dominant factor in equipping the army after 1939, and in the Autumn of 1943 30 M3A1 light tanks were received from the US, along with an equal number of M3A1 scout cars. This permitted the expansion of the tank battalion to a nominal regiment in January 1944, although this regiment consisted of only one battalion – with two 10-tank companies of LTLs and one 16-tank company of M3A1s. At the same time the former mechanized group was redesignated an armored division, although the change was more symbolic than real.

Portugal

Although the Army nominally included a tank battalion at the start of the war, the only tanks actually on hand were a few old Renault FTs and

two Vickers 6-tons (one single turret, one twin) and six Carden-Loyd Mk VI MG carriers. In late 1942 Britain agreed to supply 24 reconditioned Valentine II tanks, and a dozen more the following year, all 36 having been delivered by March 1944. Other deliveries for the Army by that time included 178 Universal Carriers and 48 Humber IV armored cars. The other force with armored vehicles was the Republican National Guard (GNR), whose motorized cavalry regiment included an armored car squadron with a mix of armored cars, including some based on Ford truck chassis with turret-mounted machine guns, and Berliet 6x6 vehicles with turrets with short-barrel 37mm guns and machine guns. The British provided an additional five Humber IV armored cars for the GNR in mid-1944.

Romania

The bulk of the armored strength up until the mid-1930s was found in 76 FT tanks purchased in 1919, 48 with the short 37mm SA gun and 28 with the Hotchkiss 8mm MG. These remained in service to the end of the war, albeit in training and security roles. In 1937 a license was acquired to build 300 Renault UE armored tractors and production began at the Malaxa factory in late 1939, but production ended with vehicle 126 in March 1941 when the supply of critical components from France ceased.



Left: A Romanian R-1 (AH-IV) tankette

Germany appears to have donated about 50 more UEs from captured French stocks in the first half of 1941.

Talks with the Czech firms of CKD and Skoda had begun in the early 1930s, but it was not until 1936 that concrete action resulted. In August a contract was signed with CKD for 35 AH-IV tankettes, to be known locally as the R-1, and another with Skoda for 126 S-II-aR (a modified version of the LT-35) tanks, to be known as the R-2. The R-1s were delivered in 1937-38. It was also anticipated that the Malaxa firm would license-produce the R-1 and the required contract was signed in September

1938, but no production actually resulted, aside from one prototype. Deliveries of the R-2s came in December 1938 to February 1939.

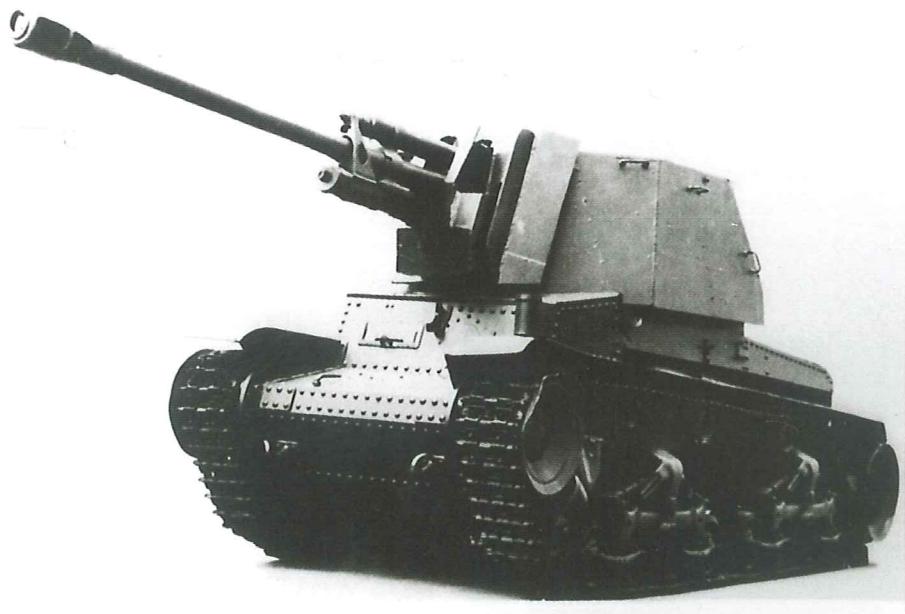
For the infantry support role the Romanians hoped to establish a plant to co-produce 200 Renault R-35s. This plan came to naught, and in the end they were only able to import 41 of these vehicles whole from France before French domestic requirements shut down the supply. The further 34 R-35s were acquired in 1939 from interned Polish equipment.

The Romanians returned to the Czech fold and attempted to purchase tanks or license production rights for a variety of Skoda and CKD/BMM

vehicles, including the T-21 from Skoda and TNH-series from CKD. All fell through. In partial compensation the Germans sold 26 used PzKw 35(t) from their holdings in October 1941, these being delivered in June-July 1942. In September 1942 they further sold 12 each PzKw IIIC and PzKw IV. A further 31 PzKw IV were sold in November-December 1943, then 83 more in the first half of 1944. Of equal significance was the sale of four StuG III in December 1943, then 104 more in the first half of 1944.

By mid-1942 it had become apparent that the Romanian tank fleet had insufficient gun power to be effective on the Eastern Front and that the Germans would not be able to provide much help. LtCol Ghiulai of the ordnance department was ordered to design stopgap systems that could assure some lethality for the armor force. His solution was to mount captured Soviet 76mm guns, available in great quantity, on the chassis of various tanks, similar to the early German Marder vehicles. He initially chose the T-60 and T-60A chassis, since a number of these were available as captured booty, and the M1936 L/51 gun. The result was known as the TACAM T-60. The turret was removed and replaced by a three-sided shield for the gun made from 15mm armor cut from captured BT tanks, while the engine was replaced by a locally-built Fargo FH.2 model. The suspension was beefed up and gun-laying controls modified slightly. Deliveries of the 34 TACAM T-60s were spread out over 1943. An almost identical conversion was undertaken using the chassis of the R-2 tank. Twenty vehicles were converted in the first half of 1944.

Of less utility was the conversion of some R-35 tanks to a nominal tank-hunter role. This was accomplished by extending the front of the turret forward to accommodate a 45mm Soviet tank gun in place of the short 37mm piece. In the process the coaxial machine gun was lost, so the tank's utility as a general offensive weapon was reduced. In any event, by the time the conversion process got going in early 1944 the 45mm was no longer an effective anti-tank



Left: A Romanian TACAM R-2 tank destroyer (PMK)



Right: Spanish PzKw I tanks on parade

weapon. A total of 30 vehicles were so rearmed.

Development of an indigenous tank destroyer, similar in overall outline to the German/Czech Hetzer, was begun in 1943 and five prototypes of the vehicle, known as the Maresal, had been completed by August 1944. Series production had been ordered, but was cancelled when Romania switched sides.

Following the defection to the Allies, Romania continued to field the existing vehicles, no Soviet vehicles being received.

Spain

The first tanks bought by Spain were a response to the humiliating defeat of Spanish forces in Morocco in 1920-21. In August 1921, the Spanish bought 12 FTs from France, 11 with 7mm Hotchkiss machine guns and one radio tank. On 18 March 1922 they were committed to combat with disappointing results due to poor co-ordination. Further purchases in the 1920s included six Schneider CA-1 tanks and seven Model 1923 St. Chamond wheel/track disasters. In 1926 development of an improved version of the FT was begun and six of the resultant Trubia tanks were built (the last in 1931).

Armored cars were procured for the "Guardia de Asaltos" paramilitary force, which had been formed in 1932 and by 1934 had 14 battalions, each including an armored car platoon. Taking an American Dodge 4x2 - model 1930 the shipyard at Bilboa designed an armored body with a machine gun turret. Two series were produced: one of 36 vehicles for the Guardia and one of 14 for the cavalry's new armored car group.

The outbreak of the civil war brought a flood of military equipment into the country. On the Republican side, the first shipment of 50 T-26 Model 1933s from the USSR arrived in October 1936 and a total of 281 had been delivered by the time the last shipment was unloaded in March 1938. In addition, 50 BT-5s were also delivered in August 1937. Also included were about 50 armored cars, FAI light

Right: Captain Verdeja developed numerous tracked vehicles, including a 45mm-armed tank, shown, but none passed prototype stage.



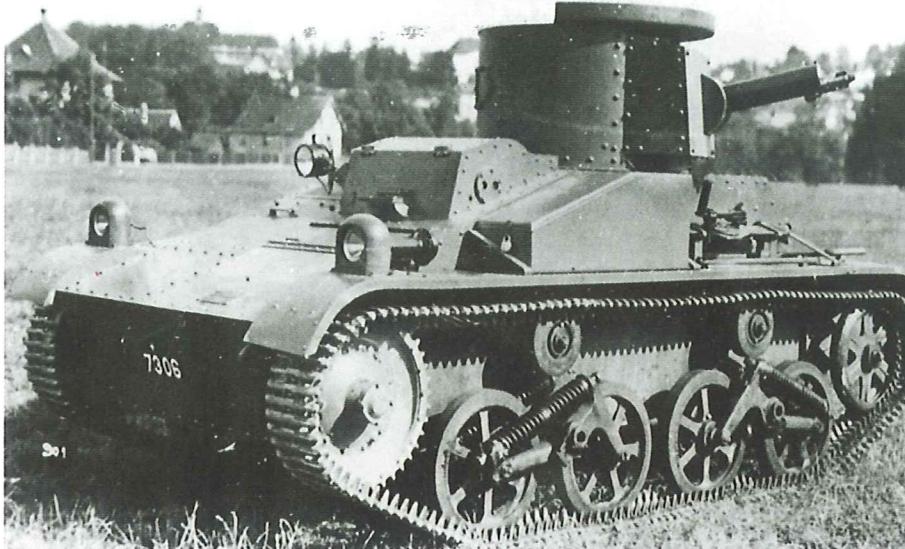
models and BA-3 heavy vehicles. By May 1938 the Republic force included 126 tanks and 291 armored cars, the vast majority of the latter being extemporized vehicles on truck chassis.

On the Nationalist side, the first German-made tanks, 32 PzKw IA and one kl.PzBefWg arrived in October 1936. Deliveries probably totalled 88 PzKw I (evenly split between A and B models) and four light command tanks. Italy appears to have sent about 100 CV.35 tankettes.

The conclusion of the civil war found the victorious nationalists with a variety of armored vehicles, German and Italian, that had been given to them, and Soviet that they had captured from the Republicans. The

reorganization directive of October 1939 formed four nominal tank regiments, each to consist of an anti-tank gun company and two tank battalions; of the latter, however, only one in each regiment was provided with vehicles. Each regiment's operational battalion held 31 light tanks and 27 gun-armed tanks. In the 1st, 3rd and 4th Regiment that meant a combination of Pz Is and T-26s, in the 2nd Regiment L3s and T-26s. The cavalry branch was organized into 10 reconnaissance groups and an armored car squadron. The reconnaissance groups were not identically organized, but each generally included a mechanized battalion that included an armored





Left: The Vickers Armstrong Type 33 light tank in Switzerland

later and these three (two with 37mm one with MG) were still on the army rolls in 1940. As part of the motorization program of the mid-1930s, two Vickers Carden Loyd Model 1933 light tanks were purchased for trials in March 1934. One, with leaf springs, was designed the Typ 33 and the other, with coil springs, the Typ 34. These were followed by four Model 35 light tanks from the same firm, delivered in the Spring of 1935. All six were armed only with a single machine gun, and a search was launched for a more capable tank armed with a cannon.

A competition between the Landsverk L-60 and the CKD TNH was won by the latter and a contract for 24 vehicles was placed in December 1937. The first twelve Pzw 39 were delivered complete (except armament) and the remainder as kits for local assembly. The Swiss fitted their own Saurer-Albon engine and a locally-designed 24mm tank gun. Secondary armament was two Maxim 7.5mm machine guns, one coaxial and one in the hull front. Delivery was completed in April 1939. In 1941 a prototype tank destroyer was built using a lengthened Pzw39 chassis with a 75mm gun mounted as in a German Marder, but it never entered production. A second prototype, with a fully-enclosed superstructure, was built

squadron with either L3s or Chevrolet 1937 armored cars. Two mechanized cavalry regiments were formed in 1940, each of which included an armored group of an armored car squadron (10 Chevrolet or BA-six armored cars), a light tank squadron (10 L3s) and a tank squadron (10 T-26).

Although further reorganizations took place, the lack of real accretions to strength limited their usefulness until 1943. To assure Spanish friendship during the war Germany implemented the Bär program in 1942, which regularized trade and promised arms deliveries. Spanish officers visited Germany later that year and placed orders for, among other items, 50 PzKw IVH and 10 StuG-IIIG. In anticipation of these modest reinforcements German advisors had suggested, in early 1942, establishing an armored division and that was officially done in mid-year. The 1st Armored Division was built around two armored brigades (each of a motorized battalion and a tank battalion) and an armored reconnaissance battalion.

Twenty of the tanks and the 10 StuGs were delivered in 1943, but the remaining tanks were never delivered due to pressing German requirements and the difficulty of transporting them across southern France. With these deliveries the Spanish Army's armored vehicle

park consisted of 93 PzKw I A/B, 116 T-26B and 20 PzKw IVH tanks; 60 L3 tankettes; 80 Chevrolet M1937 armored cars; and 10 StuG IIIs. On arrival the PzKw IVs were assigned to a medium tank company of 10 vehicles in each of the two armored division tank battalions. The assault guns were assigned to an experimental and demonstration company at the school of artillery.

Switzerland

The first two tanks, FT-17 models, were purchased in 1921. A third vehicle was added



Right: the PzW 39 with its 24mm gun and furer-type MG on a AA mount

Right: The Thai Vickers SP 2pdr AA guns on display

in 1944 but also proved a dead-end.

In addition, about a dozen Renault R-35s were taken into service in 1940 after being brought across the border by retreating French troops.

Thailand

The first purchase of armored vehicles came in 1929 when 10 Mk VI machine gun carriers were purchased from Vickers, these being delivered in March 1930. They remained a loyal Vickers customer for the next 10 years, purchasing six armored cars (on 6x4 Morris chassis with a turreted 8mm MG) in 1930 for delivery in June 1931, and then 10 six-ton single-turret tanks in November 1932 for delivery in February–March 1933. Thailand became the world's first purchaser of a tracked, armored anti-aircraft vehicle when, in January 1933, it bought 26 thinly-armored Vickers tractors armed with 2pdr AA guns. These were delivered up to October 1933.

In 1933 they returned to Vickers to purchase two amphibian light tanks and the following year bought 30 Mk VI machine gun carriers and 10 trailers, these being delivered in 1934–35. Finally, an order was placed in



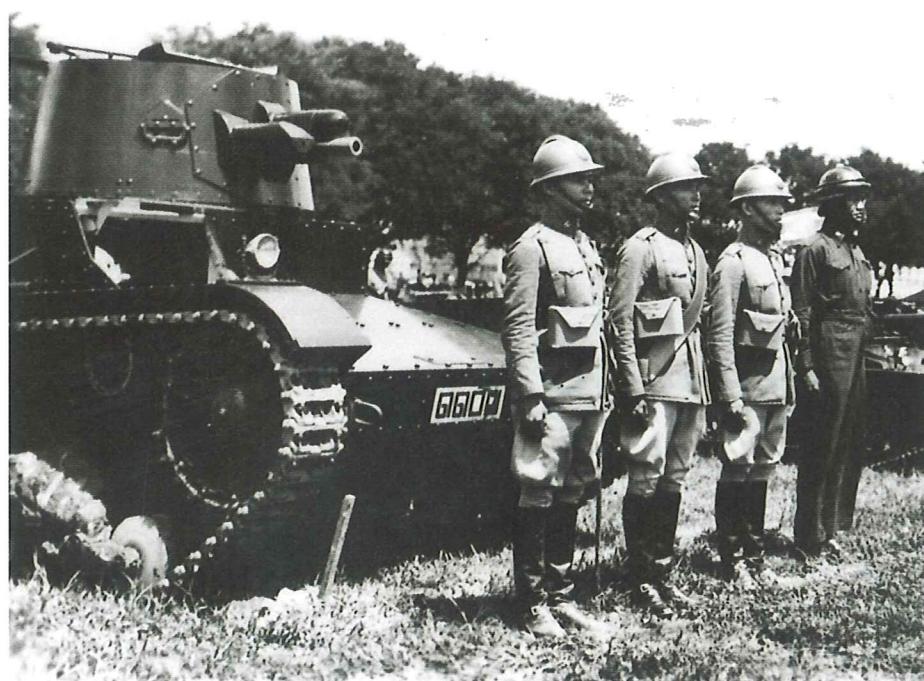
1938 for 12 more single-turret 6-ton tanks but only four were actually shipped before deliveries were halted by the outbreak of the war in Europe. The war ended the supply from the UK and Thailand turned to Japan, taking delivery of 36 Type 95 light tanks in 1940. This completed the force structure, consisting

during the war of one British-equipped and one Japanese-equipped tank battalion.

Turkey

The pre-war Turkish armored force was built around a contract with the Soviet Union that saw the delivery in 1935 of 60 T-26 Model 1933 tanks, five T-27 tankettes and 60 BA-6 armored cars. The outbreak of the war caused France and Britain to court Turkey, and this resulted in the delivery of further small quantities of AFVs. France delivered 50 R-35 light infantry tanks in January 1940 and Britain 16 Mk VIB light tanks at the same time.

Turkey's geographic location guaranteed that competition for her favor would continue. In September 1942 Churchill directed that tanks be made available in the form of 170 Stuarts, almost immediately increased to 210 Stuarts and 200 Valentines. Deliveries began in November and continued through 1943. By the end of 1943 the Turks had also requested 500 Shermans to form two armored divisions. By this time, however, Turkish indecision on entering the war, their receipt of weapons from Germany, and a general shortage of armored



Left: A Vickers medium E (six ton) and MG carriers at inspection in Thailand

	1940	1941	1942	1943	1944	1945
Renault R-35	50	-	-	-	-	-
British Light Mk VIB	16	-	-	-	-	-
M3 Stuart	-	-	23	354	-	-
Valentine	-	-	22	-	-	100
Sherman	-	-	-	34	-	-
PzKw III	-	-	-	22	-	-
PzKw IVH	-	-	-	22	-	-
Bishop SP 25pdr	-	-	-	48	-	-

Wartime AFV Deliveries to Turkey

vehicles on the Allied side had caused the British to lose their patience. Deliveries to Turkey were stopped in March 1944, by which time Turkey had received almost 400 Stuarts and Valentines, all tired vehicles from the Middle East and Persia/Iraq theaters, and 34 Shermans that were no longer fit for service. Deliveries did not begin again until February 1945, when Turkey declared war on Germany. The Valentines, the most numerous tank in the inventory, were almost all 2pdr armed versions, with only a few Mk IX.

Uruguay

Three Citroen-Kegresse P-28 armored half-tracks were purchased from France in 1933-34,

but were used by the quasi-military Guardia Metropolitana Uruguaya rather than the army. No further armored vehicles were acquired until late in World War 2, when 40 M3A1 light tanks were delivered by the US between November 1944 and June 1945. These were issued to the 4th Cavalry Regiment, creating a light tank battalion.

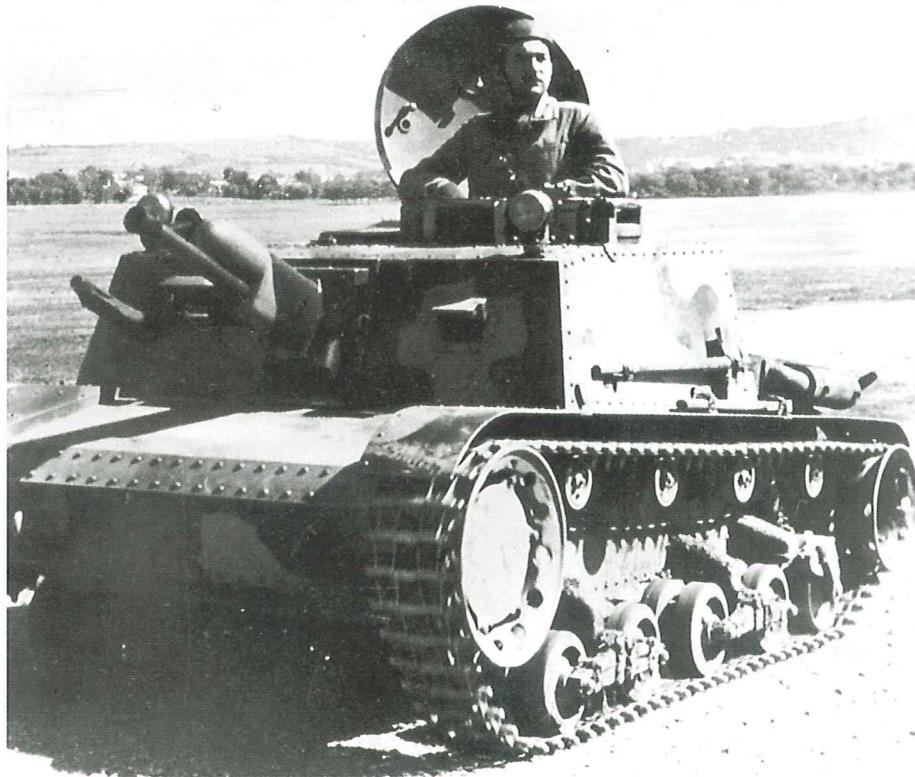
Venezuela

Two Carden-Loyd Mk VI MG carriers were purchased in 1928 and delivered the next year, the only purchase of armored vehicles until the delivery of six M3A1 Scout Cars from the US in 1942. There were no further acquisitions until after the war.

Yugoslavia

The army acquired eight FT-17s in 1920 and a further 48 in 1930, along with nine new NC-27. Eight Skoda S-I-d tankettes with a two-man crew and a 37mm A3 gun in the hull were delivered in 1937. Interest then turned to France and an order for 50 R-35s was placed, these being incorporated into a French contract with Renault of May 1938. These vehicles were delivered in February 1940.

After the fall of Yugoslavia the partisans used captured armor intermittently. As the war in the Balkans became more conventional permanent armored units were required and the 1st Tank Brigade was formed under Allied auspices, then shipped to Yugoslavia. This used a wide variety of equipment, including L3 tankettes captured from the Italians and H-35 tanks from the Germans. During the second half of 1944 the British delivered 52 M3A3 Stuart light tanks from Italy (and, reportedly 24 AEC III & IV armored cars), and in the first half of 1945 an additional 40 Shermans (five M3 and 35 M3A1) and a Lynx 2 scout car. Some of these were converted to crude SP weapons by removing the turrets and replacing them with various pieces of captured weaponry.



Left: One of eight Skoda S-I-d tank destroyers (PMK)

Index

INDEX

Page references in *italics* refer to illustrations. Where an illustration is immediately adjacent to a description of the vehicle, then only the one page reference is given.

4.7 cm Pak(t) auf PzKw IB self-propelled anti-tank vehicle 105
7TP light tank 149
7.5 cm Pak40 auf PzKw II self-propelled anti-tank vehicle 106
8.8cm Pak43 auf PzKw III/IV self-propelled anti-tank vehicle 106
15cm sIG auf PzKw I Bison heavy fire support vehicle 107
37L tractor 83
38M Toldi light tank 119
39M Csaba armored car 121
40M Nimrod self-propelled gun 120
40M Turan medium tank 119
40M Zrinyi assault gun 121

A

A9 cruiser tank 33
A10 cruiser tank 33
A11 infantry tank 38
A12 infantry tank 38
A13 cruiser tank 34
A15 cruiser tank 35
A22 infantry tank 40
A24 cruiser tank 35
A30 Avenger tank 26
AB armored car 133
Achilles tank destroyer 25
AEC armored car 44
Afghanistan 213, 214
AH-IV tankette 66
Alecto assault gun 26
amphibians, United States 195-196
amphibious tanks, Japan 144

AMR-33 scout tank 81
AMR-35 scout tank 81
anti-aircraft vehicles
 Bohemia and Moravia 69
 Britain 28, 45-46
Arab Legion 57, 57
Archer tank destroyer 26, 41
Argentina 213-214, 214
armored assault carriers, Germany 105
armored cars
 Britain 27-28, 42-44
 France 81-82
 Germany 93-94, 109-111
 Hungary 121
 Italy 127, 133
 Poland 149
 Soviet Union 158-159, 170-171
 Sweden 180-181
 United States 193-194, 209-210
armored personnel carriers, Sweden 181
Army Ground Forces 187, 188
assault guns
 Britain 25-26
 Germany 90-92, 101-102
 Hungary 121
 Italy 126-127, 131-133
 Soviet Union 157-158, 167-170
 Sweden 180
Australia 49-52, 51, 52, 61
Austria 214, 215
Avenger tank 26

B

B-1 bis medium tank 80
BA-10 armored car 159, 171
BA-20 armored car 170
BA-64 armored car 171
Beaverette 28
Belgium 214-215, 215
Bishop self-propelled gun 41

Bison heavy fire support vehicle 107
Bohemia and Moravia 65-66, 67-69
 anti-aircraft tanks 69
 light tanks 67-69
Bolivia 215, 216
Brazil 215-216
Bren Gun Carrier 47
Britain 17-47
 anti-aircraft tanks 45-46
 anti-aircraft vehicles 28
 armored cars 27-28, 42-44
 assault guns 25-26
 carriers 28-29, 46-47
 cruiser tanks 20-23, 33-37
 infantry tanks 23-24, 38-40
 light reconnaissance cars 45
 light tanks 20, 30-32
 medium tanks 32
 prewar tanks 17-19
 prewar vehicles other than tanks 19-20
 self-propelled artillery 26
 self-propelled guns 41
 tank destroyers 25-26, 41
 United States tanks 24-25
British Somaliland 57
Brummbär armored assault carrier 105
BT fast tank 164
Bulgaria 216

C

Canada 50, 52-53, 52, 53, 59-60
Carden-Loyd carrier 19, 46
carriers
 Britain 28-29, 46-47
 France 83
 Italy 127
 Japan 145
 Sweden 181
Cavalier tank 35
cavalry tanks, France 80

INDEX

cavalry vehicles, France 73-75
Centaur tank 36
Challenger tank 37
Char B-1 tank 72
Chenillette UE 83
Chi-Ha medium tank 142
Chi-He tank 143
Chi-Nu tank 143
Chile 216-217
China 217-218, 217, 218
Christie, J Walter 11, 183
Churchill tank 16-17, 24, 40
Colombia 218
combat cars
 Japan 141
 United States 197
combined-arms operations 14
Comet tank 20, 23, 37
Costa Rica 216
Covenanter tank 21, 34
Coventry armored car 27-28, 44
crew size 12
Croatia 218
Cromwell tank 36
Crossley armored car 26
cruiser tanks, Britain 20-23, 33-37
Crusader anti-aircraft tank 46
Crusader tank 35
Csaba armored car 121
CTLS light tank 200
Cuba 216
Czechoslovakia 62-69
 light tanks 67-69
 tankettes 66

D

D medium tank 79
Daimler armored car 27, 43
Denmark 177, 18
Department of Tank Design 21, 23

Dingo scout car 61
Dodge armored car 76
Dominican Republic 216

E
East Africa 57
Ecuador 218
Eire 218
El Salvador 216
Elefant assault gun 102
Estonia 218-219
expertise-expansion programme 18

F
fast tanks, Soviet Union 164
FCM 36 light tank 70-71, 79
Federated Malay States 57
Ferdinand assault gun 102
Finland 219-220, 219
Firefly tank 25
firepower increases 9-10
FlakPanzer 38(t) anti-aircraft tank 69
FlakPanzer IV anti-aircraft tank 109
flame-thrower tanks 151, 152
France 70-83
 armored cars 81-82
 carriers 83
 cavalry tanks 80
 cavalry vehicles 73-75
 Free France 76
 infantry vehicles 71-73
 light tanks 77-79
 medium tanks 79-80
 scout tanks 81
 tracked tractors 83
 Vichy regime 75-76
 wartime production 75
Free France 76
French Colonies 73-74, 75
FT light tank 77

G

Germany 84-113
 armored assault carriers 105
 armored cars 94, 109-111
 assault guns 90-92, 101-102
 captured vehicles 95
 half-tracks 94-95, 111-113
 pre-war 85-86
 self-propelled anti-aircraft vehicles 93-94, 109
 self-propelled anti-tank guns 92-93
 self-propelled anti-tank vehicles 105-106
 self-propelled artillery 93, 107-108
 tank destroyers 90-92, 103-104
 tanks 86-90, 96-100
Grant tank 201
Greece 220
Grille tank 68
Guatemala 216
 gun motor carriages, United States 206-207
Guy Wheeled Light Tank 27

H

H-35 tank 74
H-39 light tank 77
Haiti 216
half-tracks
 Germany 94, 111-113
 United States 192-193, 207-208
Hamilcar glider 19, 31
Harry Hopkins tank 31
heavy tanks
 Italy 131
 Soviet Union 156-157, 165-166
 United States 189-190, 203
Hellcat tank destroyer 190, 204
Hetz tank 69
high quality designs

INDEX

Centurion 17
CKD TNH 64
Comet 23, 37
Hetz 69
Jagdpanther 104
PzKw IV 98
PzKw V Panther 99
PzKw VI Tiger 100
Somua S-35 74
T-34 155-156, 163
Ho-Ha armored personnel carrier 145
Ho-Ni self-propelled gun 138, 144
Ho-Ro self-propelled howitzer 145
Honduras 216
Hornisse self-propelled anti-tank vehicle 106
Hotchkiss tank 11, 77
Humber armored car 27, 43
Humberette 28
Hummel self-propelled artillery 108
Hungary 114-121
Hungary
 armored cars 121
 assault guns 121
 light tanks 119
 medium tanks 119
 self-propelled guns 120
Hybrid Stuart tank 185

I
IeFH 18/2 auf PzKw II self-propelled artillery 107
India 50, 56, 61
India pattern wheeled carrier 61
infantry tanks
 Britain 23-24, 38-40
 Soviet Union 164
infantry vehicles, France 71-73
Iran 220-221, 220
Iraq 221, 221

Irish Free State 218
IS heavy tank 165
ISU-122 assault gun 170
ISU-152 assault gun 158, 170
Italy 122-133
 armored cars 127, 133
 assault guns 126-127, 131-133
 carriers 127
 foreign-built vehicles 127-128
 heavy tanks 131
 light tanks 129
 medium tanks 129-130
 pre-war 123-124
 RSI 128
 self-propelled artillery 127
 tankettes 128
 tanks 124-126

J
Jagdpanther tank destroyer 104
Jagdpanzer IV tank destroyer 103
Jagdpanzer IV/70 tank destroyer 103
JagdPz 38(t) tank 69
Jagdtiger tank destroyer 104
Japan 134-145
 amphibious tanks 144
 carriers 145
 chaotic production 135
 combat cars 141
 light tanks 141
 medium tanks 142-143
 pre-war 134-135
 self-propelled guns 144-145
 tankettes 140
 wartime production 134-140

K
Ka-Mi amphibious tank 144
Kama proving ground 85
KV heavy tank 166

L
L3 tank (Hungary) 114-115, 116
L3 tank (Italy) 124
L3 tankette 128
L6 light tank 129
L-180 armored car 180
L-181 armored car 180
Laffly armored car 82
Lanchester armored car 42
landing vehicles tracked, United States 196, 210-211
Landsverk armored cars 180
Landsverk company 173-177
Latvia 221
Lee tank 201
Lend-Lease
 Britain 24-25
 Soviet Union 159-160
light reconnaissance cars, Britain 45
light tanks
 Bohemia and Moravia 67-69
 Britain 20, 30-32
 Czechoslovakia 67-69
 France 77-79
 Hungary 119
 Italy 129
 Japan 141
 Poland 149
 Soviet Union 153-154, 161-162
 United States 185-186, 197-200
Lithuania 221
Locust tank 199
Lorraine 37L tractor 83
low quality designs
 Covenanter 21
 FT light tank 77
LT-35 light tank 62-63, 67
LT-38 light tank 67

INDEX

LVT landing vehicles tracked 196, 210-211

Lynx armored car 177, 188

M

m/31 tank 176

m/37 tankette 174, 178

m/38 tank 172-173, 175, 178

m/39 tank 178

m/40 tank 178

m/41 tank 177

m/42 armored personnel carrier 181

m/42 tank 179

m/43 assault gun 180

M1 combat car 197

M1 light tank 197

M2 half-track 207-208

M2 light tank 184, 197

M2 medium tank 201

M3 half-track 182-183, 192, 207-208

M3 Lee/Grant medium tank 201

M3 light tank 198

M3 scout car 209

M4 half track 207-208

M4 Sherman medium tank 186, 202

M5 half track 207-208

M5 light tank 199

M7 howitzer 195

M7 self-propelled artillery 205

M8 armored car 15, 210

M8 self-propelled artillery 205

M9 half track 207-208

M10 tank destroyer 203

M11 medium tank 122-123, 125, 129

M13 anti-aircraft half-track 206

M13 medium tank 126, 130

M13 self-propelled artillery 206

M14 anti-aircraft half-track 206

M15 anti-aircraft half-track 206

M16 anti-aircraft half-track 206

M17 anti-aircraft half-track 206

M18 Hellcat motor gun carriage 190

M18 Hellcat tank destroyer 204

M22 Locust light tank 199

M24 light tank 200

M26 heavy tank 203

M36 tank destroyer 204

Malaya 57

Manchukuo 222

Marder II self-propelled anti-tank vehicle 106

Marder tank 68

mark I cruiser tank 33

mark I light anti-aircraft tank 45

mark I light tank 30

mark I Matilda infantry tank 14, 38

mark II cruiser tank 33

mark II light anti-aircraft tanks 45

mark II light tank 30

mark II Matilda infantry tank 14, 38

mark III cruiser tank 34

mark III light tank 30

mark III Valentine infantry tank 23, 39

mark IV Churchill infantry tank 16-17, 24, 40

mark IV cruiser tank 34

mark IV light tank 30

mark V Covenanter cruiser tank 34

mark V light tank 30

mark VI Crusader cruiser tank 35

mark VI light tank 18, 30

mark VII Cavalier cruiser tank 35

mark VII light tank 31

mark VIII light tank 31

Marmon-Herrington

 armored car 58

 CTLS light tank 200

 tanks 191-192

Matilda tank 14, 38

 medium tanks

Britain 32

France 79-80

Hungary 119

Italy 129-130

Japan 142-143

Soviet Union 154-156, 162-163

United States 186-189, 201-202

Mexico 222

Mobelwagen anti-aircraft tank 109

Morris light reconnaissance car 45

N

Nashorn self-propelled anti-tank vehicle 106

Netherlands 222, 222

Netherlands East Indies 222-223, 222

New Zealand 50, 53-55, 54

Nicaragua 216

Nimrod self-propelled gun 120

O

Ostwind anti-aircraft tank 109

P

P-16 armored car 74, 81

P40 heavy tank 131

Panhard 178 armored car 82

Panther tank 99

Paraguay 223

Persia 220-221, 220

Peru 223

Poland 146-149

 armored cars 149

 light tanks 149

 tankettes 148

Portugal 223, 223

pre-war

 Britain tanks 17-19

 Britain vehicles other than tanks 19-20

 Germany 85-86

INDEX

Italy 123-124
Japan 134-135
Soviet Union 151-153
United States 183-185
Soviet Union 155
United States 187
production tonnage 12-13
PzJag 38(t) tank 68
PzKw 35 (t) tank 62-63, 67
PzKw 38(t) tank 67, 86
PzKw I tank 96
PzKw II tank 96
PzKw III tank 97
PzKw IV tank 98
PzKw V Panther tank 99
PzKw VI Tiger tank 15, 89, 100

R
R-35 light tank 78
R-40 light tank 78
radio 11-12
Ram tank 59
Renault D tank 79
Renault R-35 tank 78
Renault R-40 tank 78
Rolls Royce armored car 42
Romania 223-224, 224

S
S-35 cavalry tank 80
Sav m/43 assault gun 180
scout cars, United States 209
scout tanks, France 81
SdKfz 101 tank 96
SdKfz 121 tank 96
SdKfz 124 self-propelled artillery 107
SdKfz 131 self-propelled anti-tank vehicle 106
SdKfz 135/1 self-propelled artillery 108
SdKfz 138 tank 68

SdKfz 139 tank 68
SdKfz 140 anti-aircraft tank 69
SdKfz 141 tank 97
SdKfz 142 assault gun 101
SdKfz 161 tank 98
SdKfz 162 tank destroyer 103
SdKfz 165 self-propelled artillery 108
SdKfz 166 armored assault carrier 105
SdKfz 167 assault gun 102
SdKfz 173 tank destroyer 104
SdKfz 184 assault gun 102
SdKfz 186 tank destroyer 104
SdKfz 221 light armored car 109
SdKfz 222 light armored car 109
SdKfz 223 light armored car 109
SdKfz 231 heavy armored car 110
SdKfz 232 heavy armored car 110
SdKfz 233 heavy armored car 110
SdKfz 234 heavy armored car 111
SdKfz 250 light armored half-track 94, 111-112
SdKfz 251 medium armored half-track 113
SdKfz 260 light armored car 109
SdKfz 261 light armored car 109
SdKfz 263 heavy armored car 14, 110
self-propelled anti-aircraft vehicles, Germany 93-94, 109
self-propelled anti-tank guns, Germany 92-93
self-propelled anti-tank vehicles, Germany 105-106
self-propelled artillery
 Britain 26
 Germany 93, 107-108
 Italy 127
 United States 194-195, 205
self-propelled guns
 Britain 41
 Hungary 120

Japan 144-145
Semoventi 47 assault gun 131
Semoventi 75 assault gun 128, 132
Semoventi 90 self-propelled artillery 133
Semoventi 105 assault gun 132
Sexton self-propelled artillery 26
Sexton self-propelled gun 60
sFH 13/1 auf Lorraine Schlepper self-propelled artillery 108
sFH 18/1 auf PzKw III/IV Hummel self-propelled artillery 108
Sherman tank 24-25, 186, 188, 202
Shinhoto Chi-Ha medium tank 143
Siam 227, 227
Singapore 57
SKP m/42 armored personnel carrier 181
Slovakia 66
Somua S-35 tank 80
South Africa 48-49, 50, 55-56, 55, 58, 59
Soviet Union 151-171
 armored cars 158-159, 170-171
 assault guns 157-158, 167-170
 fast tanks 164
 heavy tanks 156-157, 165-166
 infantry tanks 164
 Lend-Lease 159-160
 light tanks 153-154, 161-162
 medium tanks 154-156, 162-163
 pre-war 151-153
 tank destroyers 157-158, 169
Spain 225-226, 225
SS type bridge layer 134-136
Staghound armored car 28
Straussler, Miklos 115, 118
Straussler, Nicholas 20
Strv m/37 tankette 174, 178
Strv m/38 tank 172-173, 175, 178
Strv m/39 tank 178
Strv m/40 tank 178

INDEX

Strv m/42 tank 179
Sturmgeschütz 40 assault gun 101
Sturmgeschütz 7.5cm assault gun 84-85, 90, 101
Sturmgeschütz 8.8cm Pak 43/2 assault gun 102
Sturmgeschütz IV assault gun 102
Sturmpanzer IV armored assault carrier 105
SU-12 assault gun 167
SU-15 assault gun 167
SU-76 assault gun 167
SU-85 assault gun 168
SU-100 tank destroyer 169
SU-122 assault gun 168
SU-152 assault gun 169
Sudan 57, 57
Sweden 172-181
 armored cars 180-181
 armored personnel carriers 181
 assault guns 180
 carriers 181
 tankettes 178
 tanks 178-179
Switzerland 226-227, 226

T

T14 light tank 200
T16 light tank 200
T-17 armored car 209
T-26 infantry tank 153, 164
T26 tank 189
T-28 medium tank 162
T-34 medium tank 150-151, 156, 163
T-35 heavy tank 152, 165
T-37 light tank 161
T-38 light tank 161
T-40 light tank 161
T-60 light tank 161
T-70 light tank 162

T-80 light tank 162
tank destroyers
 Britain 25-26, 41
 Germany 90-92, 103-104
 Soviet Union 157-158, 169
 United States 190-191, 203-204
tankettes
 Czechoslovakia 66
 Italy 128
 Japan 140
 Poland 148
 Sweden 178
Tanks (not subdivided by size)
 Germany 86-90, 96-100
 Italy 124-126
 Sweden 178-179
Tetrarch tank 31
Thailand 227, 227
Tiger tank 15, 89, 100
TK tankette 148
Toldi tank 119
tracked tractors, France 83
Transjordan 57
Turan tank 119
Turkey 227
type 1 medium Chi-He tank 143
type 1 Ho-Ni self-propelled gun 138, 144
type 2 Ka-Mi amphibious tank 144
type 3 Chi-Nu medium tank 143
type 4 Ho-Ro self-propelled howitzer 145
type 89 medium tank 10, 137, 142
type 92 combat car 141
type 94 tankette 138, 140
type 95 light tank 141
type 97 Chi-Ha medium tank 142
type 97 improved Shinhoto Chi-Ha medium tank 143
type 97 tankette 140
type 98 light tank 141

U

UE Chenillette 83
United States 182-211
 amphibians 195-196
 armored cars 193-194, 209-210
 combat cars 197
 export of Marmon-Herrington vehicles 191-192
 gun motor carriages 206-207
 half-tracks 192-193, 207-208
 heavy tanks 189-190, 203
 landing vehicles tracked 210-211
 light tanks 185-186, 197-200
 Marmon-Herrington tanks 191-192
 medium tanks 186-189, 201-202
 pre-war 183-185
 scout cars 209
 self-propelled artillery 194-195, 205
 tank destroyers 190-191, 203-204
Universal carrier 29, 47
Uruguay 228

V

Valentine tank 23, 39
Venezuela 228
Vichy France 75-76
Vickers 6-tonner tank 17
Vickers carriers 47
Vickers commercial light tank 32
Vickers medium E tank 32

W

Windsor carrier 60
Wirbelwind anti-aircraft tank 109
wz.34 armored car 149

Y

Yugoslavia 227, 227

Z

Zrinyi assault gun 121

Production tables

PRODUCTION TABLES

armored cars	tank destroyers 91	self-propelled artillery
Britain 27	tanks 88	Britain 26
Czechoslovakia 64	tanks pre-war 86	Germany 93
Sweden export orders 177	half track vehicles, United States 193	Soviet Union 155
United States 193, 194	heavy tanks	United States 195
armored half-tracks, Germany 94	Soviet Union 155	South Africa 50
assault guns	United States 187	Soviet Union
Britain 25	Hungary 117	heavy tanks 155
Germany 91	India 50	Lend-Lease 160
Australia 50	infantry tanks	light tanks 155
Bohemia and Moravia 65	Britain 21, 22	medium tanks 155
Britain	France 73	pre-war 154
armored cars 27	Italy 127	self-propelled guns 155
assault guns 25	Japan	shipments from Britain 160
carriers 29	pre-war 137	shipments from United States 160
conversions 22	wartime 139	Sweden
cruiser tanks 22	Lend-Lease	armored cars 177
infantry tanks 22	Britain 24-25	export orders 177
Lend-Lease 24-25	Free France 76	tanks 176
light tanks 22	Soviet Union 160	tank destroyers
orders pre-war 19	light tanks	Britain 25
scout cars 27	Britain 21, 22	Germany 91
self-propelled artillery 26	Britain 22	United States 190
shipments to Soviet Union 160	Czechoslovakia 64	tankettes, Czechoslovakia 64
tank destroyers 25	Soviet Union 155	tanks (all types), Germany 88
tanks by firm 21	United States 187	tracked amphibians, United States 196
variants 22	medium tanks	Turkey, shipments received 228
Canada 50	Soviet Union 155	United States
Caribbean shipments from United States	United States 187	armored cars 193, 194
216	New Zealand 50	exports to British Commonwealth 24
carriers, Britain 29	pre-war	half track vehicles 193
Central America shipments from United States 216	Britain 19	heavy tanks 187
conversions, Britain 22	France 73	light tanks 187
cruiser tanks, Britain 21, 22	Germany 86	medium tanks 187
Czechoslovakia 64	Japan 137	pre-war 184, 193
France 73, 76	Soviet Union 154	scout cars 193, 194
Free France, Lend-Lease 76	United States 184, 193	self-propelled artillery 195
Germany	scout cars	shipments destinations 25
armored half-tracks 94	Britain 27	shipments to Caribbean 216
assault guns 91	United States 193, 194	shipments to Central America 216
self-propelled anti-aircraft vehicles 94	self-propelled anti-aircraft vehicles,	shipments to Soviet Union 160
self-propelled anti-tank guns 92	Germany 94	tank destroyers 190
self-propelled artillery 93	self-propelled anti-tank guns, Germany	tracked amphibians 196

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